User's Manual

EnergyPro Version 5

by EnergySoft, LLC
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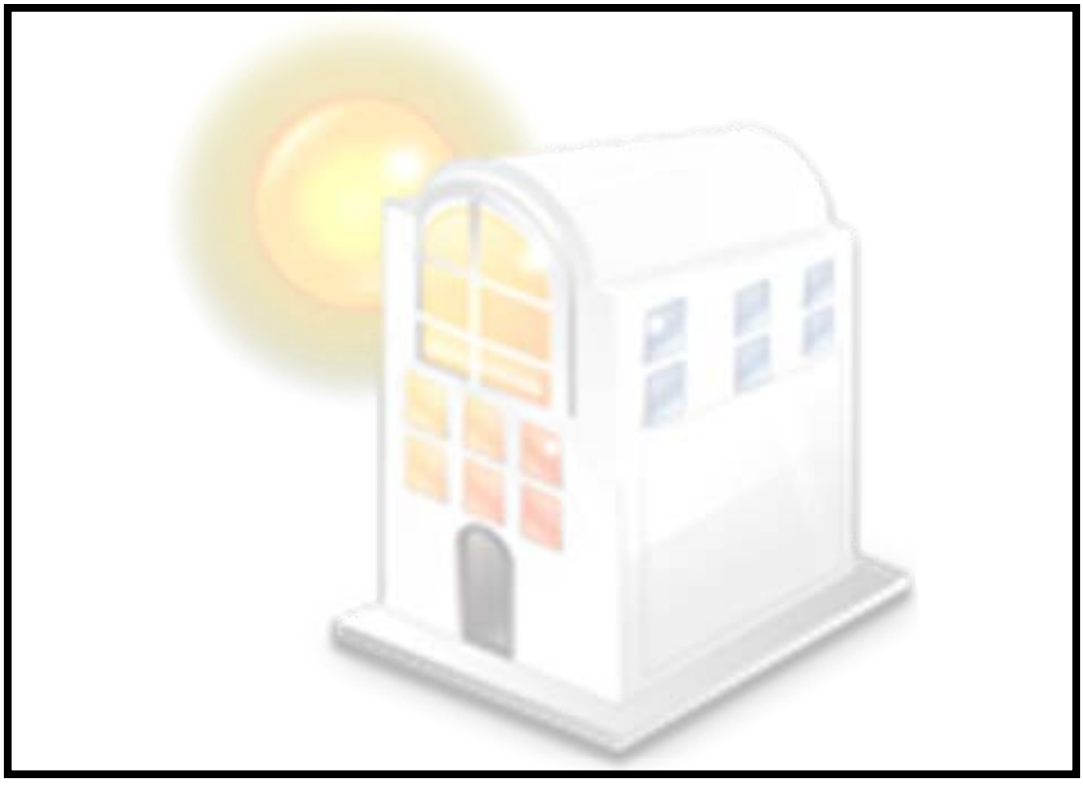

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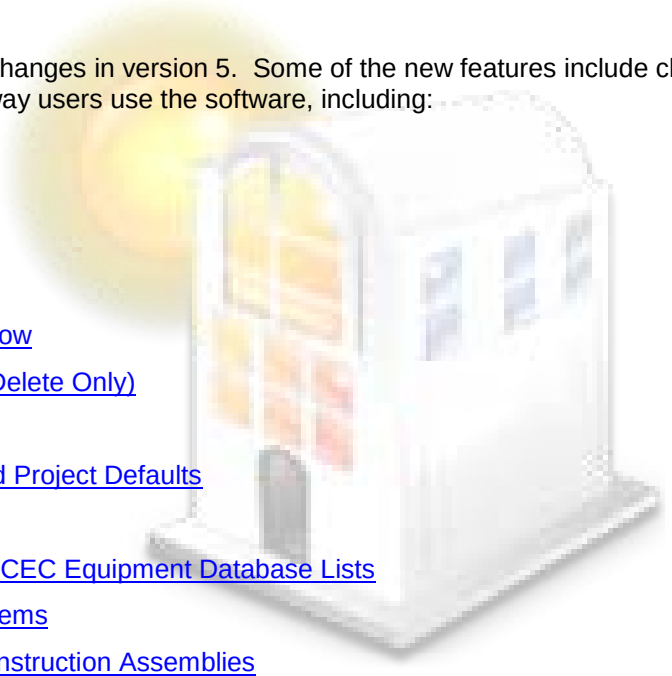
What's New In EnergyPro Version 5?



EnergyPro has undergone many changes in version 5. Some of the new features include changes to the graphical user interface, and the way users use the software, including:

- **Program Installation**
  - File Locations
  - Networks
- **User Interface**
  - Multi-Pane Window
  - Undo (Element Delete Only)
  - Building Tree
    - User and Project Defaults
  - Libraries
    - Filtering CEC Equipment Database Lists
    - Export Items
    - CEC Construction Assemblies
    - Variable Refrigerant Flow Systems
  - EnergyPro version 4 Files
  - Contacts Database
  - Metric System
- **Calculation Modules**
  - Title 24 LEED Module
  - ASHRAE 90.1 Performance Module
  - HERS Modules
  - GreenPoint Rated Module
- **Calculation Options**
  - Calibrating Results
  - Residential Alternatives
  - Calculation Processing
  - Reference Standards
  - Saving Detailed Data
  - Error Location
- **Forms and Reports**
  - Report File Format, Adobe Acrobat

- Company Logo, Signature, and Stamps
- Exporting Reports and Data
- Mandatory Measures Forms
- Acceptance Tests

Multi-Pane Window

The multi-pane window format allows users to view the Building Tree, the detailed data for the component being edited, and the most recent calculation results simultaneously. This format makes editing files more convenient and also eliminates having to open and close a dialog box each time the user wishes to edit a project feature. It also allows the user to easily and visually track the exact location of the component being edited while it's being edited.

The user can customize the panes to fit the screen in a number of ways.

- The Upper Left Window Pane displays the major program components: the Building Tree, Libraries, Calculations, Reports, and Project Defaults. You may customize the display by dragging the dividing line between the upper and lower sections up or down.
- The Lower Left Window Pane displays choices that allow you to easily switch views in the Upper Left Pane from the Building Tree to Libraries, Calculation and Report Options, or the Project Default construction assemblies. You may customize the display to show all selections in a list, only some, with the remaining choices displayed as icons, or display only icons at the bottom of the screen.
- The Upper Right Window Pane displays the detailed information about the selected item in the Left Window Pane. For example, if one selects the Zone Element of the Building Tree, the detailed entries for that Element are displayed in the Upper Right Window.
- The Lower Right Window Pane displays the most recent calculation results as well as any errors or warnings. Each different calculation is displayed on its own tab.

Undo (Element Delete Only)

If you accidentally delete an element from the Building Tree, EnergyPro now allows you to retrieve it. EnergyPro will restore the element as well as all the sub-elements contained within it. However, if you delete a sub-element first, then delete the element at a higher level in the Tree, when you select Undo, the element will be restored, but you will have to restore the sub-element separately by selecting Undo again.

Use caution when using this feature, as it will NOT undo any other entries, revisions or deletions! All other data will remain.

User and Project Defaults

User Defaults: EnergyPro version 5 contains a set of default construction assemblies that will be included in each new file. You may customize the Default Library settings by selecting Options from the Tools Menu. Select the Construction Tab in the Options dialog box, then select the default assembly construction for each envelope component. Select assemblies you use most often to automatically populate specific Building Tree elements in each new project file. Changes to User Default Construction Assemblies will be applied in the next new project file. They will not change the data in an open project.

Project Defaults: EnergyPro 5 also allows you to set Project Defaults, which only apply to the currently open project. Select the Project Defaults option in the left window pane. Select assemblies you expect to use

in your project. Each time you create a building tree element that uses one of the assemblies, EnergyPro will automatically populate the library field with the specified default assembly.

Library Functions

EnergyPro libraries contain several enhancements from previous versions, providing much greater flexibility and streamlining the way in which library items are created and used. The libraries function in generally the same way, but contain additional library command options, and are displayed in a new format that allows the user to easily view the list while editing an item.

Export Library Items

EnergyPro 5 allows the user to export library items from one project to another, eliminating the need to re-create an item for new projects. The user can export from the default libraries to any open project, or from any open project to another open project or to the default libraries for use in future projects.

Filtering CEC Equipment Database Lists

You may filter the CEC equipment list when importing items from the CEC Appliance Efficiency Databases to the Central or Boiler Libraries. Users may filter the thousands of entries in the CEC equipment lists to display only the equipment that meets specific size/capacity and efficiency criteria. You may also filter the list to show only a specific equipment type or manufacturer. This ability not only simplifies the search for a specific piece of equipment, it gives the user an estimate of the number of products available that meet the criteria.

CEC Construction Assemblies

All construction assembly values used for residential and nonresidential Title 24 compliance calculations must be from the CEC Reference Appendices Manual, Appendix JA4 – U-Factor, C-Factor, and Thermal Mass Data. If a construction assembly isn't represented in that Manual, a permit applicant or manufacturer may request approval from the CEC. For additional details regarding the CEC-approved special circumstances or construction adjustments, refer to Appendix JA4 in the CEC Reference Appendices Manual.

Variable Refrigerant Flow Systems

EnergyPro 5 now allows users to model variable refrigerant flow systems which can be used in LEED calculations for EA Credit 1 points. Title 24 compliance calculations are not able to accommodate variable refrigerant flow systems yet.

EnergyPro Version 4 Files

As a result of the changes to Title 24 rules regarding construction assemblies, when a Version 4 file is opened in EnergyPro Version 5, EnergyPro will notify the user that the file is from a previous version and that all construction assemblies must be updated.
Note that you must have EnergyPro version 4 installed in order for version 5 to read the file. Once you have opened the file in EnergyPro v5, save and close the file, then re-open it as a version 5 file.

Contacts Database

EnergyPro uses a database to store all contact information. This allows the user to simply select designers/clients from the contacts database rather than having to repeat the entries for each new project. The default location for the database is on the local drive, in the EnergyPro 5 subfolder of My Documents. The filename is EnergyProContacts.mdb. You may also place the Contacts Database on a network drive.

Modify the location of the Contacts Database by selecting Options from the Tools menu. You must re-start the software for any changes in File Locations to take effect.

Metric System

EnergyPro can display entry fields and calculation results in either the US Customary or Metric (SI) number and measurement systems. To switch from one system to the other, you must first close EnergyPro.

In Windows XP: Open the Control Panel and then open the Regional and Language Options selection. In the Regional Options tab, select the Customize… button to open the Customize Regional Options dialog box. Select either Metric or U.S. from the Measurement System drop-down list. Close the dialog boxes, and re-start EnergyPro. It automatically converts all data entries and measurement units to the selected system.

In Windows 7: Open the Control Panel and then open the Regional and Language Options selection. In the Regional Options tab, select the Additional Settings… button to open the Customize Format dialog box. Select either Metric or U.S. from the Measurement System drop-down list. Close the dialog boxes, and re-start EnergyPro. It automatically converts all data entries and measurement units to the selected system.

Residential Alternatives

EnergyPro now allows you to test the impact of individual and multiple energy-saving measures for residential projects in one action. Individual Alternatives simulate the savings from adding one individual measure to the base design at a time. Combined Alternatives simulate the cumulative impact of adding multiple measures, one after another. You may run alternatives for Title 24, HERS Ratings, GreenPoint Rated, and other residential projects.

Calibrating Results

For existing buildings, EnergyPro allows you to easily compare your simulation results to the building's actual energy usage. Each Calculation module contains a Calibration Tab that will create a graph of the monthly simulated and actual energy usage and cost (both electricity and natural gas). Use this graph to compare your simulation to the actual usage and to identify significant differences between them. This will allow you to adjust your simulation as required to closely mirror the actual building usage profile.

Calculation Processing

EnergyPro uses the full capacity of your computer's processors. If you have a multiple core processor, EnergyPro will use all cores to run the calculations, dramatically increasing the speed of simulations, especially for parametric runs or very complicated models.

The optimized processing now allows you to edit your project or another project while EnergyPro is running a simulation.

Title 24 LEED Performance Module

You may use EnergyPro's T24 LEED module to calculate compliance with the LEED rating system in California via the Title 24 compliance method for the determination of the EAc1 point score for the optimization of building energy use. However, the LEED methodology requires the inclusion of additional end uses not encompassed by Title 24, including process loads, process lighting, renewables, outdoor lighting and exceptional savings measures. In addition, while Title 24 looks at the TDV energy use of the building, this module is designed to look at energy cost as required by LEED. This module uses the DOE-2.1E* v119 software engine licensed from the Department of Energy to provide a highly accurate hourly simulation of building energy use. Documentation produced by this module includes the EAC-1 worksheet which can be used to complete the LEED template.

ASHRAE 90.1 Performance Module

Use the NR ASHRAE 90.1 Performance module to perform energy simulations for projects outside CA, to document compliance with the LEED Energy and Atmosphere requirements. You may also use the 90.1 module for those projects that are covered under the ASHRAE 90.1 Standard instead of (or in addition to) Title 24. You may select either the current version, ASHRAE 90.1-2007, or the previous version of the standard, ASHRAE 90.1-2004 to set the baseline assumptions against which the proposed project is compared. For LEED calculations, direct EnergyPro to use the ASHRAE 90.1-2004 or 2005 Title 24 baseline. EnergyPro's new 90.1 Performance module automatically creates the ASHRAE 90.1 baselines for your project.

HERS Modules

You may now use one of EnergyPro's three HERS Modules to produce the data required for a CA Whole-House Home Energy Rating (HERS Rating). The CA HERS Rating Index provides a reference against which residential projects are compared to produce a HERS score between 0 and 250 points, with a score of zero meaning the home is a zero net energy home. The reference home, which yields a score of 100, complies with CA 2008 Energy Efficiency Standards.

EnergyPro HERS calculation results display the TDV energy for each end use and the total HERS Index score for both the CHERS standard home and the Rated Home. As with all other residential modules, you may also evaluate alternative energy-savings measures, either individually, or as a cumulative package.

GreenPoint Rated Module

EnergyPro now offers a Residential GreenPoint Rated module that enables you to calculate the number of energy points using the GreenPoint Rated rating system, developed by Build It Green. The GPR calculation produces three sets of results that allow you to compare the energy performance of the rated project to the CA HERS Rating Index and the GreenPoint Rated standard. As with all other residential modules, you may also evaluate alternative energy-savings measures, either individually, or as a cumulative package.

EnergyPro's GreenPoint Rated module also produces a GreenPoint Rated report that includes an HVAC system and loads summary, an energy use and cost summary, and the GPR-1 Form (similar to Title 24 CF-

1R Form). Form GPR-1 documents the detailed energy features of the home as well as the number of energy points the project is eligible to earn through the GPR rating system.

Saving Detailed Data

EnergyPro allows you to save detailed data for each simulation module in the EnergyPro 5\Results sub-folder. The default setting removes all temporary and detailed data files after the simulation is complete. You may elect to save input and some output files for additional analysis outside the program. This feature can be a very helpful trouble-shooting tool. The program creates a sub-folder for each calculation module, that includes both the project name and calculation module for easy identification.

Residential modules create an input file and/or a comma separated values output file that includes hourly temperature and loads data for each end use. Nonresidential modules create the hourly loads data and the simulation input and output files.

Refer to the Detailed Calculation Data topic for additional details.

Error Location

When a calculation is run, EnergyPro's Input Diagnostic tool displays messages for each data item in question in the lower right window pane. Messages range from Information to Errors and also include HERS-related messages. EnergyPro's Input Diagnostic now includes error location assistance. Double-click on the message in the Location list box, and EnergyPro automatically displays the Building Element that is the message's source.

Report File Format, Adobe Acrobat

EnergyPro 5 reports and forms are now created in Adobe Acrobat™ (.pdf) format, which greatly simplifies common report-related tasks such as printing and emailing reports, and importing forms into AutoCAD™ or other applications.

EnergyPro 5 also allows you to export file data for uploading to a HERS Provider web site, either for Title 24 registration or creating HERS Rating Reports.

Refer to Exporting Reports and Data for additional details.

Company Logo, Signature, and Stamps

You may place three files in the EnergyPro Forms folder to automatically include your signature, company logo and/or a stamp such as the CABEC Certified Energy Analyst (CEA) stamp in the reports.

Company Logo: If you wish, EnergyPro will include your company's logo on the cover page of each report. You must first save the logo as .bmp file format, name the file "logo.bmp", and place the logo.bmp file into the EnergyPro Forms sub-folder. If you accept the installation defaults, as discussed in the Program Installation topic, the Forms subfolder will be located at C:\Program Files\EnergyPro 5\. If the program was installed on a network drive, the Forms folder will be located in the EnergyPro folder.

Signature: To include your signature on the title 24 CF-1R or PERF-1C forms, save your electronic signature file in the .jpg format, name the file "signature.jpg", and place the signature.jpg file into the EnergyPro 5 Forms sub-folder.

Stamp: The Title 24 compliance forms also include a space in which you may include a stamp following the same process as described above, except that you must name the file "stamp.jpg".

You may modify the files at anytime; changes take effect immediately.

Mandatory Measures Forms

Title 24 mandatory measures forms are no longer printed as a checklist. All mandatory measures are listed on the residential mandatory measure form (MF-1R) and the nonresidential (ENV-MM, LTG-MM, MECH-MM) forms. When you prepare your reports, select Reports from the list in the lower left pane, and check the box to the left of the report name (Nonresidential Title 24 Performance, etc.). Click on the "+" sign next to the checkbox to display all forms related to that report. Place a check in the box adjacent to each form you wish to include in the report.

Acceptance Tests

Acceptance tests are one way to help ensure that equipment, controls and systems operate as intended and as required by the Standards. Acceptance Test requirements in the 2008 Title 24 Standards were significantly expanded to include approximately increased the number of nonresidential measures that require Acceptance Testing. EnergyPro automatically identifies and lists which equipment or features in a particular project require acceptance testing and indicates which acceptance tests must be performed for each item. Refer to Table 2-3: Measures Requiring Acceptance Testing from the Nonresidential Manual for a complete list of measures for which acceptance tests are required.

Introduction

EnergyPro is a comprehensive energy analysis program that may be used to document compliance with CA Building Energy Efficiency Standards (Title 24, Part 6), ASHRAE 90.1 Standards, HERS energy rating systems as well as residential and nonresidential Green Building rating systems, such as GreenPoint Rated and LEED. EnergyPro is composed of an interface which includes a Building Tree and Libraries as well as several different residential and nonresidential calculation modules. The program performs several different types of calculations.

The Main Menu is the software's home base. The Main Menu is located across the top of the window that appears on your screen after you start the program. The Main Menu is the starting point and central core for managing files, moving into the Building Tree, running calculations, preparing reports, and accessing on-line Help.

This introduction provides an overview of the various program components as listed below. You may find additional details about each subject within the other chapters in the Help system. If you are not familiar with the software or the energy standards, or you do not have much experience with building energy analysis, read the rest of the Introduction and Building Tree Overview carefully.

What's New in EnergyPro 5?

Overview

- General Program Procedure
- Program Installation
  - Network Installations
- What types of buildings may you analyze with **EnergyPro**?
- What building information do you need for **EnergyPro**?
- Reference Standards
- Building Tree
- Libraries
- Modules and Calculations
  - Input Diagnostic
- Sample Files
- Creating Reports
  - Printing Reports
  - Exporting Reports

References

- CEC Publications
- DOE-2.1E Publications
- ASHRAE Publications

General Program Procedure

For many residential and some nonresidential buildings, you may use one of the Building Wizards to create a new file. Each Building Wizard automatically leads you through the steps to define the building features and applicable calculations.

1. **Open and Save:** Open a new file and give it a project name. immediately choose **File/Save As…** and name the file with the project name.
2. **Customize Libraries if Necessary:** You may use the existing entries in the libraries if applicable, modify them, or create new items in each library. Each building description file has its own unique set of libraries which are saved, along with the overall input, to the active job file. A second set of libraries, the Default Libraries, is accessible from every job file. The Default libraries can include assemblies, glazing, equipment or other entries which you want to have available for many different projects. If you modify the libraries before constructing the Building Tree, the features you need will be readily available. You may also create a set of default entries for the envelope construction components, that will be specific to this project. If you prefer to customize the libraries as you go, you may access each library from within the various Building Tree elements. (See Libraries for more complete instructions for editing libraries.)
3. **Construct the Building Tree:** Each element in the Building Tree is preceded by an icon to provide a visual cue to assist you in making entries. You will include the project title and location, and other general identifying information such as your name, as you begin at the top of the tree. Once you complete the general project information, add new elements to the Building Tree to describe each component of the building, including the Plant, Systems, Zones, Rooms, Lighting, and Envelope features. Detailed descriptions of each element in the Building Tree are provided in the Building Tree Information topic and in Building Tree Overview.
4. **Run Calculations:** After you completely describe your building in the Building Tree, select the type of calculations you wish to run. Running Calculations lists step-by-step procedures.
5. **Print Reports:** The program allows you to print reports and full-page graphic forms which are reproductions of those used by state and other standards agencies. The **Report Wizard** makes it easy to prepare a report for printing. Details for preparing a printed report are provided in Printing Reports**.**

EnergyPro Installation

The EnergyPro Version 5 installation process is now more consistent with other software, with Program and Project files installed and stored separately. The installation wizard will walk you through the process.

Program Files: EnergyPro 5 program files are now automatically installed on the local drive in the Program Files folder, in the EnergyPro 5 subfolder, unless you specify another location, such as a network drive. Refer to Network Installations for more information about running EnergyPro 5 from a network.

Project Files: EnergyPro 5 creates a subfolder in My Documents, also entitled EnergyPro 5. This sub-folder contains all the working files, including project files, default libraries and detailed simulation results.

Contact Database: EnergyPro v5 uses a database to store all contact information. This allows the user to simply select designers/clients from the contacts database rather than having to repeat the entries for each new project. The default location for the database is on the local drive, in the EnergyPro 5 subfolder of My Documents. The filename is EnergyProContacts.mdb. You may place the contacts database on a network installation also.

Libraries, Projects, and Results: You may modify the location of the Libraries, Projects, Results, and Contacts by selecting Options from the Tools menu. You must re-start the software for any changes in File Locations to take effect.

System Requirements:

- 32-bit or 64-bit, Windows Operating System (Windows 2000, XP, Vista, and 7)
- Hard Disk: 250 MB of free space
- RAM: 1 GB
- High speed Internet connection (cable or dsl) for downloading updates

Moving EnergyPro to a Different Computer: When moving to a new computer, you must first uninstall EnergyPro on your existing computer. Select Software Activation from the Help Menu, and EnergyPro will open the "Install EnergyPro License" dialog box. Click the Uninstall button at the bottom of the dialog box. You may now install the software on a different computer.

Network Installations

The Software can be installed to a network drive for use by multiple users. It is recommended that the Library files (Assembly.lib, Central.lib, etc.) be installed to a local drive, so each user can personalize their own default library entries. Installing the libraries to a local drive is optional, however, if installed to a network drive, the last user to exit EnergyPro will have their libraries saved to the network, effectively overwriting other network users' changes.

To install the *Software* to a network:

1. The software must be installed on each local computer from the Software CD.
2. Install the Software from a workstation to a shared location on the network.
3. Create a Windows Shortcut from the networked install on the desktop.
4. Start the Software from the short cut and select Options from the Tools menu. Under the File Locations tab, enter the local drive and path name for the Libraries and Projects in the Select Folders section of the dialog box.

In addition, it's recommended that you install the Results folder on a local drive. Users may elect to save the detailed simulation results from the calculations. If the Results folder is located on a network drive EnergyPro will stream the data across the network, potentially slowing down network operations. Refer to Calculations for additional details about saving detailed simulation results.

You must re-start the software for any changes in File Locations to take effect.

What types of buildings may you analyze with EnergyPro?

- Low-rise Residential buildings (use Residential Performance (Title 24 and non-Title 24), Residential Loads, CA Home Energy Efficiency Ratings, GreenPoint Rated, and CalCERTS Home Energy Ratings)
- High-rise Residential buildings (use NR Prescriptive, Nonresidential Performance (Title 24 and non-Title 24), Nonresidential Loads, LEED Title 24 Performance Compliance, and ASHRAE 90.1 Performance Compliance)
- Hotels/Motels (use NR Prescriptive, Nonresidential Performance (Title 24 and non-Title 24), Nonresidential Loads, LEED Title 24 Performance Compliance, and ASHRAE 90.1 Performance Compliance)

- Nonresidential buildings (use NR Prescriptive, Nonresidential Performance (Title 24 and non-Title 24), Nonresidential Loads, LEED Title 24 Performance Compliance, and ASHRAE 90.1 Performance Compliance)
- Outdoor Lighting (Use NR Prescriptive Outdoor Lighting, LEED Title 24 Performance Compliance, and ASHRAE 90.1 Performance Compliance)

What building information do you need for EnergyPro?

Before you try to perform any Title 24 compliance analysis, it is essential that you have the most recent editions of certain manuals from the California Energy Commission listed as References ***in the Introduction. These publications contain key explanations of the Standards and include information you need to run EnergyPro.***

Once you are familiar with these state manuals you can start analyzing buildings for compliance with Title 24, Part 6. To do an analysis you need various types of project information. Obtain the information from the building plans or by discussing the project with the designer and other consultants. In some cases, you must make preliminary assumptions. It is a good idea to study the building plans and specifications carefully before sitting down in front of the computer.

For a new project you typically need to input:

- Basic title block information (i.e., Project Title, Designer, etc.)
- Location and climate zone
- Floor, wall, roof and glazing areas
- Construction assemblies and glazing types for the building
- Characteristics of the project's HVAC, Lighting and DHW systems

If the project has common assemblies, glazing types and the HVAC and DHW systems, you may often use the pre-defined entries in the libraries. Other inputs, such as thermal mass type and area for residential buildings, or lighting watts-per-square-foot for nonresidential, are required for some projects but not for others. This is covered in the detailed explanations in Libraries and Building Tree**.**

Reference Standards

EnergyPro allows the user to select one of three reference standards the program will use to apply set the baseline energy consumption and to calculate compliance margins. Select Options from the Tools Menu, and then the Miscellaneous tab to select one of the following reference standards:

- 2001 Title 24 / 2004 ASHRAE
- 2005 Title 24 / 2004 ASHRAE
- 2008 Title 24 / 2007 ASHRAE

The selected reference standard is displayed in the status bar in the lower-right corner of the window. Note that irrespective of the Title 24 standard selected for the simulation, the report will appear on the 2008 Title 24 forms.

Building Tree

Construct the Building Tree by entering the building description of an unlimited number of thermal Zones and HVAC Systems as explained in the Building Tree Overview and Building Tree, Information topics. The building description includes the specification of all envelope characteristics, installed lighting power and controls (applicable primarily to nonresidential buildings), domestic hot water and HVAC systems.

Place your mouse over the Building, Plant, System or Zone Elements in the Building Tree to display the conditioned floor area for that element.

Libraries

Program libraries contain commonly used systems and components, and allow you to create, modify and store additional frequently used items, as well as specific entries needed for a particular project, as documented in the main Libraries topic.

The **Assembly Library** is used to define and calculate the R-Values, U-Factors and heat capacities of walls, ceilings, floors and doors based upon specified components, framing percentage and framing material.

The **Fenestration Library** is used to define glazing characteristics. Fenestration Library entries included with the software contain default U-Factors and the corresponding National Fenestration Rating Council (NFRC) Solar Heat Gain Coefficient (SHGC) values required by the California Energy Commission (CEC).

Overhang and **Sidefin Libraries** are used to define horizontal and vertical shading devices, and contain sample entries for typical overhang and sidefin configurations.

The **Central System Library** is used to define the central system components of the HVAC system. This library lets you define standard HVAC system equipment and you may also load equipment information for CEC-certified HVAC equipment into these libraries using the Import function.

The **Zonal Library** is used to define the zonal-level components of built-up HVAC systems, such as VAV boxes or Variable Refrigerant Flow units.

The **Plant Libraries** are used to define Chillers, Cooling Towers, and DHW/Boiler systems for both domestic hot water and space conditioning. You may also load information on CEC-certified water heaters and boilers into this library using the CEC equipment directories provided with the program.

The **Luminaire Library** is used to define light fixtures, including lamp and ballast types and total wattage for each fixture.

The **Schedule Library** is used to set weekly and yearly schedules associated with occupants, lights, equipment, infiltration, DHW, processes, heating, cooling, and fans for a typical week and year. In addition, you may use the Schedule Library to define utility rates. Schedules related to loads calculations and internal gains are used by the NR Loads and NR Performance noncompliance calculations. For Title 24 compliance, NR Performance uses internally fixed schedules. These schedules are set by the California Energy Commission and cannot be changed by the user. Utility rate schedules can be used to determine energy costs in any of the nonresidential performance calculations.

Modules and Calculations

EnergyPro has several calculation modules which may be purchased as packages or separately, generally categorized as Title 24 Modules and Other Calculations. Both categories contain Residential and Nonresidential (NR) Performance modules as well as Load Calculation modules.

Once you create a building description file, you may perform any of either the residential calculations or nonresidential calculations, depending on the occupancy type and the modules you have installed. You may select which calculations you would like to run by selecting the Calculations option in the lower left window pane, placing a check in the checkbox next to each calculation type and selecting the specific features of each calcuation from the Calculation options window in the upper right window pane.

Title 24 Modules:

- Residential Title 24 Performance, an hourly energy simulation used to determine and document Title 24 compliance of low-rise residential buildings. It shows compliance with the standards by comparing

the proposed energy use to a standard energy budget based on the building design as documented in Chapter 7 of the Residential Manual.

- Residential Loads which calculates residential design heating and cooling loads including room by room load calculations, using ASHRAE Handbook of Fundamentals procedures to determine the proper size of the HVAC system.
- Nonresidential Title 24 Prescriptive modules which compute and document nonresidential, high-rise residential, and hotel/motel envelope, interior and outdoor lighting, and mechanical system compliance with Title 24 prescriptive requirements.
  - Envelope: evaluates building envelope compliance using the CEC Overall Envelope compliance method as described in Chapter 3 of the Nonresidential Manual.
  - Indoor Lighting: evaluates indoor lighting compliance using the Complete Building, Area Category, or Tailored compliance methods, as explained in Chapter 5 of the *Nonresidential Manual*.
  - Outdoor Lighting: evaluates outdoor lighting compliance, including signs, as described in Chapter 6 of the Nonresidential Manual.
  - HVAC and Loads: determines compliance of the HVAC system using the prescriptive method, as described in Chapter 4 of the Nonresidential Manual. The calculations also include nonresidential heating and cooling loads using the ASHRAE TFM sizing methodology as published in the ASHRAE Handbook of Fundamentals to determine the proper size of the HVAC system. The cooling analysis is an hourly analysis that explicitly models solar gain and response factors of all construction assemblies. In addition, the module can perform room by room load calculations for buildings with up to 1,024 user-defined zones.
- Nonresidential Title 24 Performance (DOE-2.1E) compliance calculation which predicts annual building energy performance based on an hourly simulation as explained in Chapter 7 of the *Nonresidential Manual*.

Other Calculations Modules:

- Lowrise Residential Performance allows you to calculate the energy performance of low-rise residential buildings when no code or compliance baselines are involved. This module will perform an hourly simulation on the building, and determine annual energy consumption and energy cost.
- California Home Energy Efficiency Rating Services (CHEERS). Developed in partnership with CHEERS, this module performs home energy rating calculations on existing California homes for use with the CHEERS Whole House Home Energy Rating and Energy Efficient Mortgage programs. This module produces a HERS index which rates the energy efficiency of the home, and also performs economic analysis of various energy efficiency upgrades on the home.
- CBPCA. Developed in partnership with CBPCA, this module performs home energy rating calculations on existing California homes for use with the CBPCA Whole House Home Energy Rating and Energy Efficient Mortgage programs. This module produces a HERS index which rates the energy efficiency of the home, and also performs economic analysis of various energy efficiency upgrades on the home.
- GreenPoint Rated. This module, developed in partnership with Build-It-Green, will calculate the energy point score used for compliance with the GreenPoint Rated scoring system used for rating new and existing homes. In addition, it will produce the form GPR-1 compliance certificate needed to demonstrate compliance with the GreenPoint Rated system.
- CalRatePro Home Energy Ratings. Developed in partnership with CalCERTS, this module will perform home energy rating calculations on existing California homes for use with the CalCERTS Whole House Home Energy Rating and Energy Efficient Mortgage programs. This module will

produce a HERS index which rates the energy efficiency of the home, and also allow for economic analysis of various energy efficiency upgrades on the home.

- Residential Load Calculations. Determine the size requirements of HVAC systems for low-rise residential buildings. Utilizing ASHRAE Handbook of Fundamentals procedures, this module will allow for room by room load calculations to determine the proper size of the system
- Nonresidential Performance allows you to calculate the energy performance of nonresidential buildings when no code or compliance baselines are involved. This module will perform an hourly simulation on the building, and determine annual energy consumption and energy cost. In addition, this module can be used for the Savings By Design utility incentive program as a supplement to the Nonresidential Title 24 Performance module as it will allow for calculation of the "Non-compliance" standard and proposed building energy use which can be used for incentive purposes. This module uses the DOE-2.1E* v119 software engine licensed from the Department of Energy to provide a highly accurate hourly simulation of building energy use.
- LEED Title 24 Performance Compliance. One option for documenting compliance with the LEED rating system in California is via the Title 24 compliance method for the determination of the EAc1 point score for the optimization of building energy use. However, the LEED methodology requires the inclusion of additional end uses not encompassed by Title 24, including process loads, process lighting, renewables, outdoor lighting and exceptional savings measures. In addition, while Title 24 looks at the TDV energy use of the building, this module is designed to look at energy cost as required by LEED.
  This module uses the DOE-2.1E* v119 software engine licensed from the Department of Energy to provide a highly accurate hourly simulation of building energy use. Documentation produced by this module includes the EAC-1 worksheet which can be used to complete the LEED template.
- ASHRAE 90.1 Performance Compliance. Demonstrate compliance with the ASHRAE 90.1 Standard using the Appendix G compliance methodology. This module will automatically create the four baseline runs needed to show compliance with either the 2004 or the 2007 version of the standard. For LEED compliance, the 90.1 methodology is used for projects outside of California, and can optionally be used for projects inside California.
  This module uses the DOE-2.1E* v119 software engine licensed from the Department of Energy to provide a highly accurate hourly simulation of building energy use. Documentation produced by this module includes the EAC-1 worksheet which can be used to complete the LEED template
- Nonresidential Loads Calculation which determines ASHRAE design heating and cooling loads useful for nonresidential HVAC equipment selection.
- A Nonresidential Performance (DOE-2.1E) noncompliance calculation which predicts annual building energy performance using some variable inputs which are normally fixed for compliance.

> ***NOTE:*** *This software is not endorsed, authorized or associated with the U.S. Department of Energy.*

EnergyPro analyses provide:

- Ready-to-print compliance and loads reports, including appropriate forms and supporting worksheets required for submittal to local enforcement agencies.
- Economic summaries, including time-of-use utility rates, for nonresidential and high-rise residential buildings and hotels/motels.
- A diagnostic check to detect input errors before running calculations.
- Access to an on-screen database of the CEC equipment directories that allows you to load up-to-date information on certified HVAC and water heating equipment into the program's libraries.
- Comprehensive on-line documentation, including context-sensitive help (What's this?). The software's help system also includes a complete copy of the CEC Reference Manuals for your convenience.

Sample Files

EnergyPro installs several sample files which you can use to see how a particular system or permit situation is modeled. The files are automatically installed in the Projects subfolder, and include: Residential and Nonresidential Samples, NR Built-UP VAV systems, Existing + Addition + Alteration, Outdoor Lighting, Residential Hydronic Systems, Tailored Lighting, NR Envelope and Mechanical Only, Thermal Energy Storage system files, as well as several files that highlight specific HVAC equipment.

Input Diagnostic

The Input Diagnostic feature provides five levels of diagnoses: **Error, Warning, Caution, HERS** and **Information**. When a calculation is run, the Diagnostic Wizard displays a message for each item in question in the lower right window pane. Diagnostics are shown on a separate tab for each level, which shows its location, names the Issue, and suggests a solution. In addition, the diagnostics feature includes a search function that displays the Building Tree or Library element that is the source of the message when the user double-clicks on the message in the Location box.

See also: Residential Compliance Modeling Techniques &
Nonresidential Compliance Modeling Techniques

Printing Reports

Back to Building Tree Overview

Using the Report Wizard

The software's Report Wizard makes preparing a report as easy as clicking a button. Access the Report Wizard by selecting the Report Wizard icon from the toolbar or choosing **File/Report Wizard…** from the File Menu or by selecting the Report Wizard icon from the toolbar. A wizard welcomes you to the **Select Report Type** dialog box.

To begin: Select the report type you wish to print. You may only prepare one report type at a time. The Report Wizard guides you through the rest of the process of selecting the relevant forms you wish to include in the report.

To end: In the last box, **Report Complete**, you may either select "Finish" to exit the Report Wizard or select the Print Preview button to view your report." If you select Finish, you may still preview the report by selecting the Print Preview icon from the toolbar or selecting **Print…** from the **File Menu.** EnergyPro creates a .pdf file and displays the report on-screen. Choose the print settings from the Acrobat® software to print the entire report, only selected pages, or vary the number of copies you wish to print.

Using the Menu or Toolbar

You may also view and print reports by using menu commands. First, you must select Reports from the lower-left window pane. Expand the applicable report type to see the forms available, then select the specific forms you wish to include from the list displayed in the upper-left pane.

Select **File/Print...** or **Print Preview.** Alternatively, you may select the Print Preview or Print icon from the toolbar. EnergyPro creates a .pdf file and displays the report on-screen. Choose the print settings from the Acrobat® software to print the entire report, only selected pages, or vary the number of copies you wish to print.

See also: Exporting Reports &

Company Logo

Exporting Reports and Data

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The software allows you to electronically export reports for use in other applications. The export feature is used to export data for use with Home Energy Rating System (HERS) web sites.

Exporting Data for Submittal to HERS Provider

From the software's menu, select **File/Export…** Select the file format to which you wish to export the report: Title 24 Results for Upload to HERS Providers or Home Rating Results for Upload to HERS Providers. Select the folder in which you wish to save the export file, and name the file.

Title 24 Results: The exported file, in a .zip format, contains two password-protected files for upload to a HERS Provider web site: CF-1R.pdf and Data.xml. You may not open or view the files.

HERS Rating Results: The exported file is an .xml format which you can view in Internet Explorer™ or a text editor such as NotePad™ or WordPad™.

Using Reports in Other Applications

EnergyPro reports are now created in Adobe Acrobat™ (.pdf) format, which greatly simplifies common report-related tasks such as printing and emailing reports, and importing forms into AutoCAD™ or other applications. Reports and forms can be imported in many different applications such as Word™, Corel™, or AutoCAD™. To use the file in Word, click Print Preview to display the form on screen. copy the form from Acrobat™ and paste it into Word. It will be formatted as a picture that you can resize to fit your needs. You may also use the Paste Special…feature to select a different format. You may need to set the resolution for the form in Adobe Reader® to ensure it is clear and legible in AutoCAD. Select Preferences from the Edit menu, select Page Display, and Custom. Set the resolution to 300 dpi.

AutoCAD 2010™ has a feature in the "Insert" menu called "pdf underlay". With that, you can cleanly insert pages from a .pdf file into a drawing. By saving the report as a .pdf file, you can insert whatever report pages you require into your drawings. The resulting .dwg file is small and it plots cleanly and quickly. You may also use the Paste Special function in Adobe Acrobat Reader®

You may also save the report or form as a .tif file and import it into AutoCAD™.

Follow the appropriate procedure to import forms using other applications.

See also: Printing Reports &

Company Logo, Signature, and Stamps

Building Tree

The Building Tree is the backbone of the software. It is a graphical representation of the various elements of the building you will be modeling. Each building element is represented on the screen with an icon that represents that portion of the modeled building. The Building Tree is presented in a hierarchical manner. Each parent element contains information pertinent to all its sub-elements, while each subordinate element in the tree is considered a more detailed part of its parent element. Open the Building element to display the total conditioned floor area for the building on the status bar at the bottom of the window. Enable the status bar by placing a check mark next to Status Indicator in the Tools Menu.

Click on the calculator icon preceding each input heading to determine which, if any, calculations use the input.

The Building Tree contains the following elements:

Building

Exterior Application

Signs

Plant

System

Zone

Room

Roof

Skylight

Exterior Wall

Window

Door

Interior Surface

Floor

Slab

Lighting

Task

Task Lighting

Interior Thermal Mass

Underground Wall

Underground Floor

Building Element

Project Design Data, Project Title, Designers, Utility Tab, Outdoor Tab, HERS Tab.

Use the Building element of the Building Tree to enter the building's general information. Open the Building element to display the total conditioned floor area for the building on the status bar at the bottom of the window. Enable the status bar by placing a check mark next to Status Indicator in the Tools Menu.

Project Design Data Tab

Building Name

Enter a descriptive name of the project. This should be the title of the project as shown on the plans and as known to the building department. This entry is for display only, it will not appear on the compliance forms.

Building Type

Choose a Building Type from one of the following:

- ☐ Existing - Used in Existing-plus-Addition calculations
- ☐ New - Applies to any new building or newly conditioned space that is not an addition
- ☐ Addition - Any newly conditioned floor area and volume which is associated with an existing building or an existing tenant space and is modeled alone, for compliance

☐ Existing + Addition/Alteration - See Special Topics section for a detailed description

Job Number

Enter any combination of numbers and/or letters used to identify the job file.

Front Orientation

Enter the front orientation (azimuth) of the building in degrees or select one of the eight orientations from the drop-down list. This input is used as a reference on the residential Certificate of Compliance (CF-1R); and to designate each wall input as front, left, right, or back on the residential Computer Method Summary (C2-R) and the nonresidential ENV-2 form. It does not affect the actual orientation of the walls, windows, doors, and roofs. The Front Orientation can be changed with the building Rotation input.

See also: Working with Rotation Inputs.

Rotation

Enter a value, in degrees, to rotate the front orientation, walls, windows, doors, and roofs in the building clockwise when reference (project) north is not true north.

Range & Units: 0 - 360☐

See also: Working with Rotation Inputs.

Number of Dwelling Units

Enter the number of residential dwelling units in the building. If you are modeling an addition alone, enter a decimal fraction indicating the ratio of the addition area relative to the area of the entire house (existing plus addition). The calculation is as follows: Area of addition/(Area of existing + addition).

Range & Units: 0.0 - 999.0

Location Data

EnergyPro stores weather data in the Location List. The database includes entries from all 50 states in the United States and all Provinces in Canada. Click “Select” to open the Location List and select the project location.

The list is not a standard library. You may customize existing or create new locations by selecting User Defined, then the Edit button to open the Edit Location Dialog Box.

State

The State in which the project is located will be displayed after you select a location from the location List. Click on the Select button to open the location list.

City

The City in which the project is located will be displayed after you select a location from the location list. Click on the Select button to open the location list.

User Defined Location

Check the checkbox labeled User Defined to edit the weather characteristics of the selected location.

To create a new location, select a city which is close in proximity to the city you want to identify by clicking *Select* under Location. A list of United States and Canadian cities will appear. Click on the city and click OK. Then check the box named *User Defined* and select *Edit* to open the Edit Location Dialog Box.

Edit

You must check the User Defined box to enable the Edit button. Click on the Edit button to open the Edit Location Dialog Box to add a new location or customize the characteristics of the selected location. You must complete the data in each of the four tabs and provide the appropriate weather data file if different from the existing file for the program to reference when performing calculations.

You may add locations that aren't included in the EnergyPro location database. Download the BIN file for the location from the following web site http://www.doe2.com. Place the files in the Energy Pro weather folder, usually located at the following path if installed locally-- C:\Program Files\Energy Pro 5\Weather.

Return to the Project Design Data tab of the Building Element, check the User Defined Location box, and select Edit. Browse to the Weather File list and select your file. Note that the BIN files do not replace the Design Data on the Seasonal Data tab; you must input the ASHRAE design conditions for the location, from the Handbook of Fundamentals.

Select

Click on the Select button to Select a project location from the location list.

Project Title Tab

Enter the Project name and address. The information found on these tabs will appear on the residential and nonresidential compliance forms. Any item left blank will be omitted from the printout.

Remarks

Enter any remarks and/or special project features here. Remarks appear on the PERF-1C form for nonresidential projects and the CF-1R form for residential projects, under Special Remarks/ Features.

Designer, Lighting Designer and Mechanical Designer Tabs

Enter the (Primary, Lighting or Mechanical as appropriate) Designer's name, company name, address, and contact information. The information found on these tabs will appear on the residential and nonresidential compliance forms. Any item left blank will be omitted from the printout.

NOTE: You may wish to start by clicking the Select button to create a contact entry in the Contact Database so you don't have to repeat the entries in the future.

Select…

Click the Select button to choose a Designer from the Contact Database. You may build a contact database of Designers with whom you work regularly so that for future projects, you can simply select the contact, and the information will automatically be completed.

Add to Contacts

Click the Add to Contacts button to add a Designer to the Contact Database. You may enter the detailed information for the contact either before you click the button or after, in the Select Contact dialog box.

Utility Tab

Use the Utility tab to specify the building's fuel source, corresponding Utility Rate, and to customize which DOE-2.1E reports will be included in the simulation output (.sim) file.

Utility Rate Schedules

Electricity Rate

Click in this field to select the appropriate Utility Electricity Rate. Utility rates are part of the Schedule Library.

Fossil Fuel Rate

Click in this field to select the appropriate Utility Fossil Fuel Rate. Utility rates are part of the Schedule Library.

Principal Heating Source

Select the fuel used as the principal project heating source. Choices include: Natural Gas, Propane, Electric (Natural Gas Available), and Electric (No Natural Gas Available).

DOE-2 Reports

Select the DOE-2 Reports you wish to include in the simulation results file. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file.

NOTE: DOE-2.1E bug. *DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will* ***not*** *run.*

Outdoor Tab

Outdoor Lighting Zone

Select the appropriate Outdoor Lighting Zone (1-4) for the project. The least power is allowed in Zone 1, (parks, wildlife preserves, etc.), with increasingly more power allowed in Zones 2 (rural areas), 3 (urban areas), and 4 (special use districts).

Exterior lighting applications addressed by the Standards are shown in Table 6-1, Scope of the Outdoor Lighting Requirements.

Standard Outdoor Lighting

Select the methodology for determining the Standard lighting power allowance.

Select "Use Standard" to use lighting power values designated in either Title 24 or ASHRAE 90.1 standard. The program automatically determines the allowable lighting power to be used in the Standard (Budget) Energy calculation. This is the most common selection.

Select “Use Override” if you are modeling a project for which allowed outdoor lighting levels have already been determined (i.e., by another lighting consultant) and enter the allowed lighting power (Watts) in the Use Override box.

EnergyPro will calculate the allowable outdoor lighting power for both the Title 24 and ASHRAE standards.

Proposed Outdoor Lighting

Select “Use Standard” when no outdoor lighting plans or specifications are submitted for permit

Select “Use Installed” when the Proposed (Actual) calculation will be based on the outdoor light fixtures as input in the Exterior Task Element of Building Tree. The installed LPD (including control credits) is shown to the right.

Select “Use Override” if you are modeling a project for which the installed outdoor lighting levels have already been determined (e.g., installed lighting levels have been calculated by another lighting consultant), and enter the actual lighting power (Watts) in the User Input Use Override box.

EnergyPro will calculate the allowable outdoor lighting power for both the Title 24 and ASHRAE standards.

Operating Schedule

Click in this box to select the Outdoor Lighting operating schedule from the Schedule Library.

HERS Tab

The HERS tab contains the required fields to produce a HERS rating. Enter the required data for each of the energy-using components in the house.

NOTE: If the home has solar water heating, solar space heating, or photovoltaic panels, enter the system information in the Renewables Tab of the Plant Element.

For multifamily projects with multiple pieces of equipment, enter the average data for each dwelling unit. For example, in a 20 unit multi-family project with 20 refrigerators, calculate and enter the average energy use for the refrigerators. This allows you to easily model multiple units with differing equipment or features.

Date of Rating

Click on the arrow at the right of the field to display the calendar. Select the date the rating was conducted from the calendar and HomeRatePro will automatically populate the entry field.

Rater ID

Enter the Rater ID as assigned by the HERS Provider.

Inside Refrigerator

Enter the estimated annual energy usage for the inside refrigerator. If the EnergyGuide data is available for the refrigerator manufacturer and model, use the EnergyGuide data. If the EnergyGuide data is not available, enter 775 kWh/year. The refrigerator in the HERS reference home uses 669 kWh/year.

In multi-family projects with multiple refrigerators, do not use the multiplier function. Instead, enter the average kWh of all the refrigerators.

Garage Refrigerator

If the home contains additional refrigerators or a stand-alone freezer in the garage, manually calculate and enter the total estimated annual energy usage for the unit(s). If the EnergyGuide data is available for the

manufacturer and model, use the EnergyGuide data. If the EnergyGuide data is not available, enter the default value of 1,013 kWh/year for each refrigerator and 929 kWh/year for each stand-alone freezer.

In multi-family projects with multiple refrigerators, do not use the multiplier function. Instead, enter the average kWh of all the refrigerators.

Dishwasher

Enter the Energy Factor (EF) for the dishwasher, if the actual EF is available. If the EF is not available, use 0.46. The HERS Technical Manual assumes each dwelling unit has a dishwasher. The dishwasher in the HERS reference home has an EF equal to 0.46.

NOTE: The energy usage related to the dishwasher is dependent on the number of occupants in the home. You must enter this data in the Occupant Tab of the Room Element.

Range

Select the type of Range/Oven from the drop-down list. The choices include:

- Gas No Pilot
- Gas With Pilot
- Electric

Washer Location

If there is a washer in the home, select the appropriate entry indicating whether the washer is located “In Unconditioned Space” or “In Conditioned Space”. If there is no washer in the home, select “None”.

Dryer Location

If there is a dryer in the home, select the appropriate entry indicating whether the dryer is located “In Unconditioned Space” or “In Conditioned Space”. If there is no dryer in the home, select “None”.

Dryer Type

Select either Gas or Electric to indicate the dryer fuel source.

Swimming Pool

If the home has a swimming pool, select the swimming pool characteristics from the drop-down list. Choices include:

- Gas heated with cover
- Gas heated with no cover
- Solar or not heated
- Electric heated with cover, and
- Electric heated with no cover

If there is no swimming pool, select None.

Spa

If the home has a spa or hot tub, select the spa characteristics from the drop-down list. Choices include:

- Gas Heated

- Solar/Gas Heated
- Electric Heated, and
- Solar/Electric Heated

If there is no spa, select None.

Well Pump

Check the box if the home has a Well Pump.

Sewer Grinder Pump

Check the box if the home has a Sewer Grinder Pump.

Indoor Lighting

Enter the quantity of each permanently-installed interior luminaire. Refer to Table 7 from the CEC HERS Technical Manual to determine the luminaire count for each different luminaire type. Operating hours for Interior lighting for HERS projects are shown in Table 6: Daily Lighting Hours – Interior.

Use the drop-down lists to quantify the permanently-installed interior lighting in the home. For each luminaire type, enter the number of luminaires, the location, and the type of control.

Luminaire Types include:

- High Efficacy
- Screw-in CFL
- Incandescent

Refer to Table 8 from the CEC HERS Technical Manual to determine the proper classification for each luminaire type.

Locations include:

- Small Closet
- Bedroom / Walk-in Closet
- Hall / Entry / Stairs / Other
- Living
- Utility / Laundry, and
- Kitchen/Dining/Nook

Luminaire Controls include:

- On / Off Switch
- Dimmer
- Occupant Sensor

Outdoor Lighting

Enter the quantity of each permanently-installed exterior luminaire. Refer to Table 7 from the CEC HERS Technical Manual to determine the luminaire count for each different luminaire type. Operating hours for exterior lighting for HERS projects are shown in Table 10: Daily Lighting Hours – Exterior.

Use the drop-down lists to quantify the permanently-installed exterior lighting in the home. For each luminaire type, enter the number of luminaires, the location, and the type of control.

Luminaire Types include:

- High Efficacy
- Screw-in CFL
- Incandescent

Refer to Table 8 from the CEC HERS Technical Manual to determine the proper classification for each luminaire type.

Locations include:

- Garage
- Front Entry
- Outdoor

Luminaire Control choices include:

- On / Off Switch
- Sensor (photocontrol with motion sensing for outdoor lighting, occupant sensor for interior garage lighting)

Exterior Application Element

The Standards now address general site illumination and specific outdoor lighting applications (Section 147). Exterior lighting applications addressed by the Standards are shown in Table 6-1, Scope of the Outdoor Lighting Requirements. The first column is generated site illumination applications, which allow for tradeoffs. The second column is specific outdoor lighting applications, each of which must comply on their own without tradeoffs. The lighting applications in the third column are not regulated. The Standards include control requirements as well as limits on installed lighting power

More information pertaining to the Outdoor Lighting and Signs topic can be found in Section 6 of the Nonresidential Manual.

Name

Type in a user defined name for the exterior task. This is only used to identify the task in the tree.

Application Information

Lighting (Outdoor)

Select the appropriate lighting application from the dropdown list.
Refer to Table 6-3 (Table 147-A in the Standards) General Hardscape Lighting Power Allowance or Table 6-4 (Table 147-B in the Standards) Additional Lighting Power Allowance For Specific Applications for details regarding the allowable lighting power for each exterior application.

For more detailed information on each of the tasks, refer to the Outdoor Lighting Chapter of the Nonresidential Compliance Manual.

Area / Perimeter

Depending on the application, the user may be prompted to enter the area or perimeter related to the application.

Range & Units:

Imperial (US): 0.0 - 99,999 feet

SI (Metric): 0.00 - 30,476.6 meters

Quantity

Depending on the application, the user may be prompted to enter the quantity of identical outdoor lighting applications.

Range: 0 100

Footcandle Ordinance

Select from the drop-down list to indicate the presence of an ordinance and whether the ordinance requires a minimum or average Footcandle Level.

Requirement

When a local ordinance dictates specific higher outdoor lighting levels than the state standard, indicate the footcandle requirements of that ordinance, maximum equals 4.0 footcandles. EnergyPro will automatically adjust the Title 24 Standard wattage allowance.

Calculated Data (Not a Program Input)

T-24 Standard: Displays the maximum lighting power (Watts) allowed by Title 24 based upon the Lighting Zone selected in the Outdoor Tab of the Building Element, and the Exterior Lighting Application type at the site.

90.1 Standard: Displays the maximum lighting power (Watts) allowed by ASHRAE 90.1 based upon the Exterior Lighting Application type at the site.

Proposed: EnergyPro automatically calculates and displays the lighting power for the Proposed task (Watts).

Signs Element

The sign energy Standards apply to all internally illuminated (cabinet) and externally illuminated signs, whether they are used indoors or outdoors. Examples are internally illuminated and externally illuminated signs, including billboards, off-premise and on-premise signs. They do not apply to unfiltered signs, traffic signs or exit signs. Exit signs must meet the requirements of the *Appliance Efficiency Regulations*. The sign energy Standards are the same throughout the state and are independent of outdoor Lighting Zones. New signs must meet the requirements of §130 (c) (mandatory requirements) and Luminaire Power requirements, §148. §130 (c), describes how the wattages of various lighting components are added up to calculate the total luminaire wattage. Compliance with this Section is only required for signs that comply under the Component Performance Approach, described below. §148 provides two alternative ways to comply with the sign Standards. Both alternatives encourage the use of readily available, cost-effective lighting technology.

More information pertaining to the Outdoor Lighting and Signs topic can be found in Section 6 of the Nonresidential Manual.

Name

Type in a user defined name for the sign. This is only used to identify the task in the tree.

Sign Application

Select the compliance option that most closely matched the sign design being submitted for compliance.

Alternative 1 - Component Performance Approach

Internally illuminated - Allows 12 W/f^2 times the area of the sign face. Use only one sign face to calculate the area for double-sided internally illuminated signs.

Externally illuminated - Allows 2.3 W/f^2 times the area of the sign face.

Alternative 2 - Requires that the sign be illuminated only with one or more of the following light sources. Some of the sources listed below have additional requirements. Refer to Section 148 of the Standards for details.

High Pressure Sodium

Pulse Start of Ceramic Metal Halide

Neon or Cold Cathode

Light Emitting Diode

Barrier Coat (T-5 and T-8)

Compact Fluorescent

Electronic Ballast

Sign Symbol or Code

Enter a code that identifies each sign type on the Lighting Compliance Forms.

Quantity of Signs

Enter the number of identical signs of the selected type.

Range & Units: 0 - 99,999 (units N/A)

Area

Enter the total area for the face or faces of the sign.

Range & Units:

Imperial (US): 0.0 - 999,999 ft²

SI (Metric): 0.00 - 92,899.9 m²

Lighting Technology

When using the Alternative 2 approach to sign compliance, the sign has to use at least one of the technologies listed:

High Pressure Sodium

Pulse Start of Ceramic Metal Halide

Neon or Cold Cathode

Light Emitting Diode

Barrier Coat (T-5 and T-8)

Compact Fluorescent

Electronic Ballast

Plant Element

Heating Hot Water Chilled Water Hydronic Tab DHW System Renewables Tab Exceptional Tab

Use the Plant element of the Building Tree to enter the building's Boiler, Chilled Water, Hydronic, and DHW System information.

Heating Hot Water Tab

Name

Enter a descriptive name for the Plant. Use this box to name the Plant element, whether or not the project has a Boiler, for example, "Residential DHW" for a residential project.

Hot Water Boiler

Boiler

Click in this multi-edit box to choose a Boiler from the DHW/Boiler Library. Only one type of Boiler is allowed per building, although multiple identical units are allowed.

NOTE: When you don't want to model the Central Boiler for nonresidential compliance (e.g., when modeling the envelope only or a tenant space linked to an existing Central Boiler, Chiller and/or Cooling Tower for nonresidential compliance using Win/DOE), leave the plant inputs set to undefined.

Multiplier

Enter an integer value to specify the number of identical Boiler units in the building.

Range & Units: 0 - 99 (units N/A)

Loop Setpoint Temperature

Enter the setpoint temperature for the hot water loop.

Range & Units: 32°F – 210°F

Hot Water Pump

Flow Rate per Pump

Enter the Boiler pump flow rate.

Range & Units:

Imperial (US): 0 - 99,999 gpm

SI (Metric): 0.0 - 6,309.9 L/s

HW (Hot Water) Pump Multiplier

Enter an integer value to specify the number of identical Boiler pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Pump Motor) Design Power

Enter the power output of the water loop pump at design conditions.

If pump energy is expressed in kilowatts (kW), divide kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599.25 kW

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Flow Control

Choose one of the three control options: One-Speed, 2 Way Valve; One-Speed, 3 Way Valve, or Variable Speed.

Minimum Power Ratio

Enter the ratio (expressed as a decimal) of the minimum operating speed to the maximum pump speed for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Hydronic Piping

Pipe Length

For Residential Projects using hydronic heating and there are more than 10 feet of piping located in unconditioned space, enter the total length (plan view) of distribution pipe between the primary heating source and the point of distribution.

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric): 0.0 - 3,047.7 meters

Pipe Diameter

Enter the inside pipe diameter.

Range & Units:

Imperial (US): 0.500 - 2.000 inches

SI (Metric): 13 - 51 mm

Insulation Thickness

The installed thickness of the pipe insulation. Minimum pipe insulation for hydronic systems is as specified in Standards Section 150 (j).

Range & Units:

Imperial (US): 0.500 - 2.000 inches

SI (Metric): 13 - 51 mm

Chilled Water Tab

Click on the graphic buttons to define each of the components of the chilled water system. You may define up to four types of chillers, a cooling tower, thermal energy storage sytem, secondary pumps and a chiller EMS system if one exists.

Chillers Thermal Energy Storage Secondary Pumps Chiller EMS

Number of Chiller Types

Enter the number of chiller types used in your project. You may define up to four different chiller types.

Chilled Water Supply

Enter the temperature of the chilled water supply at design conditions. Enter the chilled water suipply temperature at the ARI (or alternate) rating conditions in the Chiller Library.

Chiller Entries

Click on each chiller to define the chiller characteristics and the associated primary pumping.

Chiller

Click in this field to choose a Chiller from the Chiller Library. This entry is required for buildings with central Chillers. You may select up to four chiller types per building.

Chiller Multiplier

Enter an integer value to specify the number of identical chiller units in the central plant of the building.

Range & Units: 0 - 99 (units N/A)

Chilled Water Pump

Flow Rate per Pump

Enter the chilled water pump flow rate.

Range & Units:

Imperial (US): 0 - 99,999 gpm

SI (Metric): 0.0 - 6,309.9 L/s

Pump Multiplier

Enter an integer value to specify the number of identical primary chiller pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Pump Motor) Design Power

Enter the power output of the water loop pump at design conditions.

If pump energy is expressed in kilowatts (kW), divide kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599 kW

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Thermal Energy Storage Entries

Click on the thermal energy storage icon to define the thermal energy storage system characteristics.

Name

Enter a descriptive name of the thermal energy storage system. This entry is for display only, it will not appear on the compliance forms.

Storage Type

Select the storage type from the drop-down list. Choices include:

- Chilled Water
- Ice-on-Coil
- Ice Harvester
- Brine
- Ice-Slurry
- Eutectic
- CHS (Clathrate Hydrate Slurry)

Number of Tanks

Enter the number of storage tanks in the thermal energy storage system.

Capacity

Enter the capacity of the system in ton-hours.

Supply Rate

Enter the supply rate, or the rate at which cooling energy can be extracted from the storage tank.

Charge Schedule

Click in this field to select a charge schedule for the thermal energy storage system.

Auxiliary Energy

Enter the electricity demand from any auxiliary energy components used for pumping or devices such as air blowers used in the TES system, in kilowatts.

Tank Area

Enter the area of the wall and floor surfaces of the storage tank, in square feet. This data is used to calculate the heat transfer from the tank to the surrounding area.

Tank Insulation

Enter the R-Value of the tank insulation. This data is used to calculate the heat transfer from the tank to the surrounding area.

Secondary Chilled Water Pump Entries

Click on the pump to define the chilled water secondary pump characteristics.

Flow Rate per Pump

Enter the secondary pump flow rate.

Range & Units:

Imperial (US): 0 - 99,999 gpm

SI (Metric): 0.0 - 6,309.9 L/s

Pump Multiplier

Enter an integer value to specify the number of identical secondary pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Pump Motor) Design Power

Enter the power output of the secondary pump at design conditions.

If pump energy is expressed in kilowatts (kW), divide kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599.25 kW

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Flow Control

Choose one of the three control options: One-Speed / 2 Way Valves; One-Speed / 3 Way Valves, or Variable Speed.

Minimum Power Ratio

Enter the ratio (expressed as a decimal) of the minimum operating speed to the maximum pump speed for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Chiller EMS Entries

Click on the Chiller EMS graphic to define the chiller EMS schedule and sequence operation.

Sequences Tab

You must first click on the "+" sign to add a sequence to the table.

Sequence Name

Enter a descriptive name for each sequence.

Balance Load

Check the box if you wish to operate all chillers in each load range. Leave the checkbox blank (unchecked) if you wish to operate only particular chillers within each load range. The standard design chiller(s), as defined in the Nonresidential ACM Manual Section 2.4.2.32, operates to 90% capacity prior to the staging of the next chiller. Standard design chillers are modeled in parallel.

Range

Range

Click on the "+" sign to add a range to the table.

Load Range

Operate Chillers in this Load Range Up to:

Enter the maximum load for each load range.

Range & Units:

Imperial (US): 0 - 9,999 tons

SI (Metric): 0.00 - 74,599.25 kW

Chiller

Select chiller(s) from the drop-down list which will operate in this load range.

Chiller Multiplier

Enter the number of identical chillers which will operate within this load range.

Range & Units: 0 - 9 (units N/A)

[Total Capacity Available]

This is not a program input. The total available plant capacity at each load range is calculated automatically by the program, based on the specific chiller characteristics defined in the Chiller Dialog, and the chiller multiplier entered in the Load Range Dialog.

Schedule Tab

Sequence (defined hourly)

Select the operation Sequence Name from the drop-down list for each hour of the day.

Hydronic Tab

Ground Coupled System

Check this box if the system is a ground-coupled system. This will enable the Ground Temperatures input field to the right.

Ground Temperatures

For ground coupled systems, click in this box to select a temperature schedule from the Schedule Library. Leave this entry set to Undefined to use Ground Temperatures from the weather file.

Economizer / Condenser (Water)

If your project includes a central water-cooled condenser (one which serves all systems in the building from a central location), model the condenser pump energy here. If the water-cooled condenser is part of an individual system, enter the pump energy in the Central System Library.

Flow Rate per Pump

Enter the water side economizer or water cooled condenser pump flow rate.

Range & Units:

Imperial (US): 0 - 99,999 gpm

SI (Metric): 0.0 - 6,309.9 L/s

Pump Multiplier

Enter an integer value to specify the number of identical pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Pump Motor) Design Power

Enter the power output of the pump at design conditions.

If pump energy is expressed in kilowatts (kW), divide kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599.25 kW

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Flow Control

Choose one of the three control options: One-Speed, 2 Way Valve; One-Speed, 3 Way Valve, or Variable Speed.

Minimum Power Ratio

Enter the ratio (expressed as a decimal) of the minimum operating speed to the maximum pump speed for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Percentage Propylene Glycol in Loop

Enter the percentage of propylene glycol in the water loop, if any. Propylene glycol reduces the temperature at which the water/glycol mixture will freeze, providing anti-freeze protection in VRF condenser water loops. However, propylene glycol provides a lower heat transfer rate than water-only closed loop systems.

Cooling Tower

Cooling Tower

Click this field to choose a Cooling Tower from the Cooling Tower Library. Only one type of Cooling Tower is allowed per building, although multiple identical units are allowed.

The Hydronic Cooling Tower is used to define the tower specifically connected to:

- ☐ a water loop condenser;
- ☐ a water side economizer; or,
- ☐ a water loop (water source or hydronic) heat pump system.

While one Cooling Tower may physically serve several of these functions, it may be necessary to model it as two towers for the NR Performance simulation.

Tower Multiplier

Enter an integer value to specify the number of identical Cooling Towers in the central plant of the building.

Range & Units: 0 - 99 (units N/A)

Cooling Tower Pump

Flow Rate per Pump

Enter the Cooling Tower pump flow rate.

Range & Units:

Imperial (US): 0 - 99,999 gpm

SI (Metric): 0.0 - 6,309.9 L/s

Pump Multiplier

Enter an integer value to specify the number of identical pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Pump Motor) Design Power

Enter the power output of the pump at design conditions.

If pump energy is expressed in kilowatts (kW), divide kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599.25 kW

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Domestic Hot Water Tab

DHW Boiler

Type

Select Existing, New, Altered or Removed from the drop-down list to indicate the DHW or Boiler type.

- **Existing**

  Existing equipment that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New equipment for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the equipment is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing water heater or boiler to illustrate the equipment prior to any changes or replacement as well as a New water heater or boiler to describe the system after the alteration.

- **Removed**

  This equipment will be removed as part of an addition or alteration.

Existing/New DHW Boiler

Depending on the application, click in the multi-edit box (Existing Boiler and/or New Boiler) to choose a Water Heater or Boiler from the DHW/Boiler Library.

Multiplier

Enter an integer value to specify the number of identical water heating units in the building.

Range & Units: 0 - 99 (units N/A)

Combined Hydronic Piping

(Hydronic) Pipe Length

Enter the total length of pipe in unconditioned space for all boilers that are part of this hydronic space heating system. This input is used only in residential occupancies and should be the total length for the system, not per boiler. Make sure that if you have a multiplier input for your DHW boiler that you multiply the total pipe length and input this number.

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric): 0.0 - 3,407.7 meters

(Hydronic) Pipe Diameter

Enter the diameter of the hydronic piping associated with a hydronic space heating system.

Range & Units:

Imperial (US): 0.000 - 2.000 inches

SI (Metric): 0 - 51 mm

(Hydronic) Insulation Thickness

Enter the hydronic pipe insulation thickness associated with a hydronic space heating system.

Range & Units:

Imperial (US): 0.000 - 1.000 inches

SI (Metric): 0.0 - 25 mm

Multi-Family Central System

Check this option when the proposed design has more than 6 dwelling units. The DHW system is considered to be a Central system and requires that you describe the pump and pipes.

Monitored System

Check this box if the multi family central water heating system contains a computer modulated boiler control or hourly monitoring equipment. See Chapter 5 of the Residential Manual for additional information.

Pump

Pump - Control

Choose the type of control for the DHW recirculation pump. The choices are:
- Timer Control
- Demand Control
- Temperature Control
- Time and Temperature Controls

Pump - Multiplier

Enter an integer value to specify the number of identical DHW pumps in this system.
Range & Units: 0 - 999 (units N/A)

Design Power

Enter the power output of the hot water pump at design conditions, brake horsepower or bhp.
If pump energy is expressed in kilowatts (kW), divide kilowatts by 0.746 to convert to brake horsepower.
Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)
SI (Metric): 0.00 - 74,599.25 kW

Piping

Length Outside

Describe the central system piping by inputting the linear feet of pipe outside.

Range & Units:

Imperial (US): 0.0 - 99,999.0 feet

SI (Metric): 0.0 - 30,479 meters

Length Underground

Describe the central system piping by inputting the linear feet of pipe underground.

Range & Units:

Imperial (US): 0.0 - 99,999.0 feet

SI (Metric): 0.0 - 30,479 meters

Length in Plenum

Describe the central system piping by inputting the linear feet of pipe in plenum space.
Range & Units:

Imperial (US): 0.0 - 99,999.0 feet
SI (Metric): 0.0 - 30,479 meters

Additional ½" Insulation

Check this box if the pipe has at least ½ inch more insulation than the minimum Title 24 requirement.

Residential

Distribution

Choose the type of distribution system associated with the residential water heater. The choices are:

- No Pipe Insulation
- Kitchen Pipe Insulation
- All Pipes Insulated
- Point of Use
- Below Grade, No Insulation
- Below Grade, Insulated
- Parallel Piping
- Point Of Use
- Recirculation: No Control

- Recirculation: Timer Control
- Recirculation: Temperature Control
- Recirculation: Time and Temperature Controls
- Recirculation: Switch
- Recirculation: Motion Sensor
- Temperature Buffering Tank

Definitions of the different distribution systems, how they work, and some restrictions in their use and installation are explained in Chapter 6 of the state's *Residential Manual*.

Renewables Tab

Solar Space Heating

Net Solar Fraction

Enter the percentage of space heating load that is met by the solar space heating system. See Chapter 5 of the state's *Residential Manual* for the guidelines and the use of an approved program (e.g., f-Chart) to calculate annual solar performance.

Range & Units: 0.0 - 100.0%

Solar Domestic Hot Water

Net Solar Fraction

Enter the percentage of domestic hot water heating load that is met by the solar water heating system. See Chapter 5 of the state's *Residential Manual* for the guidelines and the use of an approved program (e.g., f-Chart) to calculate annual solar performance.

Range & Units: 0.0 - 100.0%

Electricity Production

Use this tab to enter information related to residential photovoltaic systems in projects participating in the CEC New Solar Homes Partnership (NSHP) program and nonresidential systems in LEED and ASHRAE projects. To qualify for the NSHP program, PV systems must be at least 1 kW AC capacity and installed in conjunction with higher energy efficiency requirements as described in the CEC's NSHP Guidebook. NSHP documentation must be completed by a Certified Energy Plans Examiners (CEPE).

You must use the NSHP CECPV Calculator software to calculate the expected PV system performance and to produce the required documentation. You may obtain information regarding the NSHP program requirements and download the Calculator from the Go Solar CA web site at the address below.

http://www.gosolarcalifornia.ca.gov/

Enter the output data from the Calculator in the Electricity Production table. You will have to complete some additional calculations to determine some of the inputs.

You may also find additional details in Appendix B of the 2008 Residential ACM Manual.

DC Rating

Enter the nameplate DC power rating of the photovoltaic system, in kilowatts (kW). PV module power ratings are for standard test conditions (STC) of 1,000 W/m^2 solar irradiance and 25°C PV module temperature.

TDV

Enter the annual TDV energy (in kBtu/sqft-yr) produced by the PV system. Obtain this value from the CECPV calculator results. It is subtracted from the total TDV energy use for HERS II and GreenPoint Rated analyses but is ignored in Title 24 calculations. You must convert the annual TDV energy production from the CECPV Calculator Results data from the TDV kWh units to kBtu/sqft-yr.

Production (kWh)

Enter the estimated photovoltaic system energy production for each month. You may obtain this information from the CECPV Calculator Results data.

Demand (kW)

Enter the estimated maximum demand (in kW) produced by the photovoltaic system each month. The CECPV Calculator produces a spreadsheet in comma separated values (.csv) format that lists hourly data, including system production, in Watts. You must obtain the monthly demand information from the detailed, hourly data and convert the demand from Watts to kW.

Cost

Enter the estimated electricity cost savings (in $) from the photovoltaic system each month.

Exceptional Tab

The entries on this tab apply only to LEED Innovation in Design calculations.

Name

Enter a descriptive name for the innovative or exemplary technology or strategy.

Description

Enter a brief description of the technique or strategy.

Electricity Tab

Enter the monthly energy usage, demand, and cost savings associated with the technology or strategy.

Energy

Enter the estimated renewable system energy production (nonrenewable energy savings) for each month.

Demand

Enter the estimated maximum demand (in kW) produced by the renewable system each month.

Cost

Enter the estimated electricity cost savings (in $) from the photovoltaic system each month.

Gas Tab

Enter the monthly energy usage and cost savings associated with the innovative or exemplary technology or strategy.

Energy

Enter the estimated renewable system gas savings (in therms) for each month.

Cost

Enter the estimated gas cost savings (in $) from the renewable system each month.

System Element

Use the System element of the Building Tree to enter the Heating, Ventilating, and Air Conditioning System information. The System element contains five tabs, General, Distribution, Residential, HERS Credits, and MECH-2. Use the General tab to define the System Details, the Distribution Tab to define the distribution system location and characteristics.. The Residential Tab is used to define residential system features. The HERS Credits Tab includes residential credits that require a Home Energy Rating System inspection. The MECH-2 Tab contains information that will appear on the Title 24 MECH-2 nonresidential forms.

System Details

Name

Enter a descriptive name for the System. The system name will appear on both residential and nonresidential compliance and loads documentation.

Type

Select Existing, New, Altered or Removed from the drop-down list to indicate the System Type.

- **Existing**

  An existing system that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New system for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the system is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing system to illustrate the system prior to any changes or replacement as well as a New system to describe the system after the alteration.

- **Removed**

  This system will be removed as part of an addition or alteration.

HVAC System

Depending on the application and System Type designation above, click in the multi-edit box (Existing System and/or New System) to choose an HVAC System from the Central System Library.

Multiplier

Enter an integer value to specify the number of identical HVAC units in the building.

The System Multiplier should always equal the total number of pieces of equipment used to heat and/or cool all the Zone elements listed under the System element.

In multi-family projects, if the duct leakage or other system characteristics differ in each dwelling unit, you may create a system for each unit rather than using the multiplier feature to model the unique features of each system separately.

Range & Units: 0 - 99 (units N/A)

Use Supply Air Temperatures Specified in Central System for Load Calculations

Check the box if you want the load calculations to use the supply air temperature specified in the Central System library. If you leave the box unchecked (the default assumption) the load calculations will calculate the supply air temperature depending on the system capacity and airflow.

Constant Volume Required For Process

Check the box if the system must supply constant air volume to serve a process load. Fan power required solely for process loads is excluded from the system fan power calculations.

Exempted Fan Power

Enter the fan power that is exempt from the fan power consumption requirements. Exempted fan power includes fans used solely for air treatment or filtering where the pressure drop is greater than one inch water column (or 245 pascals), or fans serving a process load. Note that only the fan energy associated with pressure drop over one-inch water column may be excluded.

Space greater than 8,000 square feet, AND Ceiling Height greater than 15 feet AND LPD greater than or equal to 0.5 Watts per square foot.

Section 143 of the Standards requires that spaces which comply prescriptively with the Nonresidential Standards that are greater than 8,000 sqft, directly under a roof with ceiling heights > 15' and Lighting Power Densities > 0.5 w/sqft must include skylights and lighting controls. Check this box if your space meets this criteria. Under the Performance Approach, this will set the baseline.

Outside Air From:

Section 121 of the Standards lists requirements for mechanical ventilation. The default value is “Outside”, indicating the outside air is supplied directly from the outdoors. If the outside air requirements for this system are supplied via one of the other HVAC systems in the building, click on the box to select one of the other Systems defined in the Building Tree. Click “X” beside the box to revert back to the default condition.

Distribution Tab

Distribution Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your distribution system.

- **Existing**

  Existing ducts that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New ducts for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the duct is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing duct to illustrate the duct prior to any changes or replacement as well as a New duct to describe the duct after the alteration.

- **Removed**

  This duct will be removed as part of an addition or alteration.

Existing and/or New Distribution Systems

Heating Distribution:

Select one of the Heating Distribution types. The choices are:

☐ Ducted

☐ Ductless / with Fan

☐ Ductless / No Fan

☐ Radiant Floor

☐ Baseboard

Cooling Distribution

Select one of the Cooling Distribution types. The choices are:

☐ Ducted

☐ Ductless

Duct Location

Select one of the duct location types. This input is used for both residential and nonresidential calculations. Refer to Section 4.4 of the Residential Manual or Section 4.4 of the Nonresidential Manual for additional details. The choices are:

- Conditioned
- Outdoors
- Crawlspace
- Garage
- Basement

- Attic, Ceiling Insulation, Unvented
- Attic, Ceiling Insulation, Vented
- Attic, Ceiling and Roof Insulation
- Attic, Roof Insulation
- Attic (Buried): For an explanation of the effects of this selection, refer to the CEC Reference Appendices, Reference Appendix 3.1. Note that this feature requires HERS verification and that the Quality Insulation Installation checkbox be checked on the HERS tab.
- Attic (Deeply Buried): For an explanation of the effects of this selection, refer to the CEC Reference Appendices, Reference Appendix 3.1. Note that this feature requires HERS verification and that the Quality Insulation Installation checkbox be checked on the HERS tab.

Duct Insulation

Input the rated R-Value of the duct insulation.

Range & Units:

Imperial (US): 0.0-999.0 (hr)(ft²)(°F)/Btu
SI (Metric): 0.00 - 174.2 (m²)(°C)/W

Less than 12 Feet of Duct in Unconditioned

Check the box if less than twelve lineal feet of ducts lie outside conditioned space. You may not use this checkbox if you have selected Ducts in Conditioned or an unducted system in the System Element, General Tab. This credit requires field verification by an approved HERS rater.

Duct Leakage Not Verified

If no duct leakage test is performed for the existing duct system, HomeRatePro assumes a default leakage value. Duct leakage factors for untested and tested duct systems are shown in Table R3-39: Duct /Air Handler Leakage Factors in the Residential ACM Manual.

Sealed Ducts with Leakage Verified

Check the box if the duct leakage has been reduced from the 22% default value to a maximum of 6%. The ducts must be tested and certified by the installer and tested and verified by an approved HERS rater. If no credit is taken for Reduced Building Envelope Leakage (which requires diagnostic testing and verification of the building envelope by an approved HERS rater), the building will also receive a pre-set credit for reducing building envelope leakage by reducing duct leakage. The credit is equal to a 0.5 reduction in the Specific Leakage Area (SLA), which is equivalent to reducing building infiltration by approximately 10%. The default value is infiltration which corresponds to an SLA equal to 4.9 for ducted systems.

If you take credit for Reduced Building Envelope Leakage, the proposed design will be modeled with the SLA as input (the building will not get the 0.5 credit in addition to the specified target SLA). The building will still receive the duct leakage credit. Refer to the *Residential Manual*, Chapter 4 for more details regarding all HERS credits and requirements.

Low Leakage AHU or HERS II Leakage Verified

Check the box if the air handler is tested and certified by the CEC as a low leakage air handler. The air handler must achieve a 2 percent or less leakage rate at 1-inch water gauge when all air inlets, air outlets and condensate drain port(s), when present, are sealed. This credit must be used in combination with the verified duct leakage credit.

%

If the measured duct leakage is less than 6% of the total airflow, enter the actual percent here. When a certified low leakage air handler is installed, you may use the actual measured duct leakage value provided the value is less than or equal to 6% of the total airflow.

Ducts in Conditioned Space with Leakage Verified

Check the box if the ducts are entirely in conditioned space, and have verified low leakage rates to the outside conditions. This credit requires field verification that the leakage rates to the outside are equal to or less than 25cfm when measured at CEC-specified conditions by an approved HERS rater.

Measured Duct Surface Area

Check the box if you wish to take credit for actual duct surface areas and R-Values in your design. To receive compliance credit, the duct layout and design specifications must be included on the plans. In addition, this credit must be field verified by an approved HERS rater. You may not use this checkbox if you have selected Ducts in Conditioned or an unducted system in the System Element, General Tab. This credit also requires that the duct design is based on an industry standard methodology, such as ACCA Manual D. The design must include data regarding the available external static pressure from the air handler, the pressure drop of external devices, the equivalent length of the duct runs, as well as the size, location, type and configuration of the ducts and fittings.

Residential Ducts [Not a Program Input]

EnergyPro automatically calculates the duct surface area and R-Value for both the standard and proposed designs. This information is used to determine eligibility for the high efficiency, verified duct design credit. This credit must be field verified by an approved HERS rater. Check the Measured Duct Surface Area checkbox, as listed above and enter the location, duct inside diameter, length and insulation R-Value in the Measured Duct Information dialog box. Refer to Chapter 4 of the Residential Manual or Section RA3.1.4.1 of the CEC Reference Appendices Manual for additional information.

Nonresidential Ducts

>25% of Ducts in Unconditioned

Check the box if the ducts are part of a single zone system serving less than 5,000 sqft, and more than 25% of the ducts are located in unconditioned space. This condition requires sealing ducts to limit leakage and field verification by an approved HERS Rater. For new ducts, leakage must be equal to or less than 6%. For new ducts added to an existing system, the leakage criteria vary depending on the specific situation. Refer to Chapter 4 of the Nonresidential Manual for additional information.

Heating Duct Losses

Enter the heating duct losses, as a percent of the total fan flow.

Cooling Duct Losses

Enter the cooling duct losses as a percent of the total fan flow.

Residential Tab

Thermostat

Select a thermostat control for residential (low and high-rise) buildings only. Nonresidential program calculations ignore this input. The choices are:

Setback control, the default or standard assumption for residential systems.

No Setback control, a selection that will provide a penalty, and is not allowed under prescriptive.

Living zone control is required in modeling the living areas of the building for credit under the zonal control exceptional method criteria.

Sleeping zone control is required in modeling the sleeping areas of the building for credit under the zonal control exceptional method criteria.

See Special Topics, Zonal Control and Section 4.5.2 of the *Residential Manual* for more details regarding Zonal Control credit requirements.

Hydronic Space Heating

Select the hydronic heating source, if one exists. This selection applies to residential occupancies only.

- Choose **None** if there is no hydronic heating in the building.
- Choose **DHW Boiler Provides Heat** for a combined residential space and water heating system that uses the specified hot water system for space heating as described in the Plant element, DHW Tabs of the Building Tree.
- Choose **Heating Boiler Provides Heat** for a dedicated (separate) space heating system that uses the heating boiler specified in the Plant element, Heating Hot Water Tab of the Building Tree.

See Also:

Hydronic Systems

House Wrap Credit

Check the box if a house wrap is installed which meets the requirements for compliance credit as explained in Section 4.2 of the *Residential Manual*. This credit reduces the overall building Specific Leakage Area (SLA) by 0.5, which is equivalent to reducing building infiltration by approximately 10%. The default SLA is equal to 4.3. You may not use this credit if you specify credit for reduced building envelope air leakage through diagnostic testing. This credit will be appear in the Special Features section of Forms CF-1R and C-2R. You may combine this credit with the Reduced Duct Leakage credit.

Lowrise Residential Mechanical Ventilation

Supply

Enter the airflow rate for the ventilation supply fan required to maintain adequate air quality in buildings with a target SLA less than 3.0. Leave the input set to 0 to use the default ventilation value.

Range & Units:

Imperial (US): 0.0 - 9,999.0 cfm
SI (Metric): 0.00 - 9,999.0 L/s

Exhaust

Enter the airflow rate for the ventilation exhaust fan required to maintain adequate air quality in buildings with a target SLA less than 3.0. Leave the input set to 0 to use the default ventilation value.

Range & Units:

Imperial (US): 0.0 - 9,999.0 cfm
SI (Metric): 0.00 - 9,999.0 L/s

Power
Enter the total Watts for the supply and exhaust fans. Leave the input set to 0 to use the default ventilation value.
Range & Units: 0.0 - 9,999 W

HERS Credits Tab

There are several compliance credits available for improving the efficiency of heating and cooling distribution system (ducts), and for improving practices to achieve higher performance and less leakage than results from standard construction practices. These HERS compliance credits require diagnostic testing and field verification by a certified HERS rater.

All of the following credits will appear on printed compliance documentation.

Related Topics:

HERS Compliance Credits

NOTE: All HERS credits require field inspection and verification by an approved HERS rater. Also refer to the *Residential Manual*, Section 2.5 and Chapters 3 and 4 for more details regarding HERS credits and requirements.

HVAC Measures

Verified Refrigerant Charge or Charge Indicator Display
Select to take the HERS credit
Refrigerant charge refers to the actual amount of refrigerant present in the system. Excessive refrigerant charge can lead to premature compressor failure and insufficient charge can cause compressors to overheat. This credit requires field verification by an approved HERS Rater.

Verified Air Conditioner EER
Select to take the HERS credit. The EER is the full load efficiency at specific operating conditions. It is possible that two units with the same SEER can have different EERs. Using the performance compliance method, credit is available for specifying an air conditioner with an EER greater than 10. When credit is taken for a high EER, field verification by a HERS rater is required (see Appendix RI in the 2005 *Residential ACM Manual*).

Verified Cooling Coil Airflow
Select to take the HERS credit
The Standards offer a compliance credit for adequate airflow, which is defined as a minimum of 400 cfm per ton (operating normally with a wet cooling coil or 450 cfm per ton when tested with a dry cooling coil). The air flow for each system must be tested using one of the methods described in Appendix RE of the 2005 *Residential ACM Manual*. This credit requires verification by a HERS rater.

Verified Fan Energy
Credit is available for demonstrating that a high efficiency fan and duct system with a low wattage fan has been installed. The contractor must test the actual fan power of each system using the procedure in Appendix RE of the 2005 *Residential ACM Manual* and show that it is equal or less than what was proposed in the compliance analysis. This credit requires verification by a HERS rater.

Verified Cooling Size (Verified Maximum Cooling Capacity)

Select to take the HERS credit, which requires field verification by a HERS rater.
With the performance method, credit is offered for cooling systems that are smaller than a prescribed criteria calculated for each proposed design. To receive credit, the installed air conditioner must be no bigger than the limit calculated by the ACM. This credit is available only in combination with the credits for verified duct sealing and testing, and verified adequate airflow.

Building Envelope

Quality Insulation Installation

Quality installation pertains to the manner in which the insulation in the home has been installed. For example, it is important to maintain contact between the ceiling insulation and the interior sheetrock that forms the air barrier to prevent convection from reducing the effectiveness of the insulation. This measure requires verification by a certified HERS Rater.

Building Leakage Testing

Check the Building Leakage Testing check box to indicate that the building will be tested to ensure reduced leakage is obtained in the completed building. You must also specify the target Specific Leakage Area (SLA) and the volume and power consumption of the ventilation fans if that SLA target is less than 3.0. If the target SLA is less than 1.5, the building must have supply ventilation which maintains "a pressure greater than -5 pascals relative to the outside average air pressure with other continuous ventilation fans operating." *Residential ACM Manual*, Section 3.9. In order to receive the credit, an approved HERS rater must perform diagnostic blower-door testing as specified in the *Residential Manual*, Chapter 2.

Building Leakage Type

If you check the Building Leakage Testing checkbox to claim credit for reduced leakage as described above, you must assign an identity or Type for the project. Select from the four options a Type that most closely matches your project.

- **Existing**

  Existing building that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New building for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the building is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing building to illustrate the building prior to any changes or replacement as well as a New building to describe the building after the alteration.

- **Removed**

  This portion of the building will be removed as part of an addition or alteration.

Existing and/or New Specific Leakage Area

If you selected Building Leakage Testing, enter the Specific Leakage Area (SLA) target for the Existing and/or New portion of the project, as appropriate. If the SLA target is less than 3.0 sqft/10,000 sqft, you must also enter the volume and power consumption of the ventilation fans in the Lowrise Residential Mechanical Ventilation section of the Residential Tab. If the target (or measured) SLA is less than 1.5, the CEC considers the building to have “unusually tight construction” per the building code and requires the building to meet

specific ventilation criteria as described in Section 4.6 of the *Residential Manual*. In order to receive the credit, an approved HERS rater must perform diagnostic blower-door testing as specified in Section 3.5.3 of the *Residential Manual*.

MECH-2 Tab

MECH-2 Features

Time Control

Select the type of time control device for the system from the drop-down list. As stated in the Nonresidential Manual*, Section 4.3.1D*, the choices include:

- ☐Programmable Switch - with weekday/weekend features.
- ☐Occupancy Sensor - for intermittently occupied spaces only
- ☐Manual Timer - for intermittently occupied spaces only

Your selection will appear on the Title 24 MECH-2 form.

Outdoor Damper

Select the type of outdoor air damper control. Choices include either Auto (motorized) or Gravity.

DP Sensor Location

Indicate the specification for the placement of the fan static pressure sensor to meet the requirements of Section 144 (c) 2C. For constant volume systems and VAV systems with DDC controls to the zone level enter “N/A”.

Supply Pressure Reset

For systems with DDC controls to the zone level indicate the sequence of operation that provides supply pressure reset by zone demand, enter “yes” or “no” depending on your design.

Natural Ventilation

The project design calls for the specifications for operable openings, their control (if appropriate) and location. Enter "yes" or "no" if your project will be using Natural Ventilation.

Pipe Insulation

Identify the specifications of pipe insulation greater than or equal to the requirements of Section 123. Note this is only for the refrigerant piping on split-systems. Hydronic insulation is identified on the form MECH-2-C (Part 2 of 3).

Zone Element

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Use the Zone element of the Building Tree to enter the Zone’s General, Lighting, Mechanical, and Schedules information.

General Tab

Zone Name

Enter a descriptive name of the Zone.

Zone Type

Select the Zone Type from the drop-down list. The choices are Conditioned, Unconditioned or Return Air Plenum. For nonresidential performance calculations, DOE 2.1E requires the first zone to be conditioned.

Occupancy

View Occupancy List

Select Single Family Detached, Single Family or Multi-Family for low-rise residential buildings. Select High-Rise Residential Living for the living spaces in multi-family dwellings with four or more habitable floors. Select an occupancy type from the remaining categories for all other occupancies covered under the Nonresidential Standards.

Select a Complete Building occupancy if all areas of the entire building are complete; the envelope, HVAC and lighting system are fully designed and submitted as part of the current permit AND the building consists of 90% one occupancy type. According to Section 5.3 of the Nonresidential Manual, you may also use the Complete Building method for tenant improvements, if 90% of the permitted space is one occupancy (exclusive of support spaces) and the support spaces make up 15% or less of the total permitted space. You may not use the Complete Building method for high-rise residential or hotel/motel buildings.

You may select an Area Category occupancy type (Auditorium through Waiting Area and All Others, or for Hospitals, Anesthesia Storage through Lab, Physical Sciences) from the Zone Level Occupancy Types list) if the zone is a nonresidential occupancy and lighting plans or specifications are submitted with the permit. (Also see Area Category Notes.)

90.1 Lighting Occupancy

Select an Occupancy to set the standard for ASHRAE 90.1 calculations.

Floor Number

Enter the number of the floor upon which the zone is located. In two- or three-story buildings, you may lump the characteristics of all floors into one zone if the floors are served by one HVAC system and you set the floor number equal to 2 for a two-story building or 3 for a three-story building.

Range & Units: 1 - 999 (units N/A)

Rotation

Use zone rotation for parts of the building which are set at an angle to the main building. The zone rotation will influence the orientations of all the walls, roofs, glazing, and doors in the zone.

Enter the rotation of the zone measured clockwise from the building rotation, in degrees. A zone rotation of zero means the zone has the same orientation as the whole building; a zone rotation from 0□ to 180□ indicates the zone is rotated to the east of the building rotation; while a zone rotation from 181□ to 359□ means that the zone is rotated to the west of the building rotation.

It is recommended that you not use this feature in residential buildings and use it judiciously in nonresidential buildings.

Range & Units: 0 - 360□

Vertical Multiplier

The Vertical Multiplier is used for buildings with a number of identical zones stacked vertically. This allows you to describe one zone and then give the number of times it occurs including the first occurrence, as a vertical multiplier. The vertical multiplier assumes that the multiplied zones are stacked directly above the bottom, which is assigned the floor number you enter. Thus, if the original zone is on the second floor and the vertical multiplier equals three, then the multiplied zones are assumed to be the second, third, and fourth floors. This will influence the compliance calculations of energy budgets.

The Vertical Multiplier does not affect the areas of demising partitions (i.e., any surfaces between adjacent zones).

If you have both a vertical and a horizontal multiplier for a zone, the total floor area for the zone equals the zone floor area times the vertical multiplier times the horizontal multiplier.

For example, a zone with a floor area of 1,000 ft² (92.9 m²), a vertical multiplier of 2 and a horizontal multiplier of 3 has a total floor area of 2 x 3 x 1,000 ft² (92.9 m²) = 6,000 ft² (557.4 m²).

To use multipliers properly, the zones must be absolutely identical, including their orientations and roof and floor exposures. The vertical multiplier usually applies only to zones on interior floors of multi-story buildings.

Range & Units: 1 - 99 (units N/A)

Horizontal Multiplier

The Horizontal Multiplier is used for buildings with a number of identical zones placed side by side. This allows you to describe one zone and then give the number of times it occurs, including the first occurrence, as a horizontal multiplier. The horizontal multiplier assumes that the multiplied zones are all on the same floor. This will influence the compliance calculations of energy budgets.

The Horizontal Multiplier does not affect the areas of demising partitions (i.e., any surfaces between adjacent zones).

If you have both a vertical and a horizontal multiplier for a zone, the total floor area for the zone equals the zone floor area times the vertical multiplier times the horizontal multiplier.

For example, a zone with a floor area of 1,000 ft² (92.9 m²), a vertical multiplier of 2 and a horizontal multiplier of 3 has a total floor area of 2 x 3 x 1,000 ft² (92.9 m²) = 6,000 ft² (557.4 m²).

To use multipliers properly, the zones must be absolutely identical, including their orientations and roof and floor exposures. The vertical multiplier usually applies only to zones on interior floors of multi-story buildings.

Range & Units: 1 - 99 (units N/A)

Display Perimeter (North, East, South)

Enter the North, East, South orientation length, in feet, of an exterior wall in a Group B, Group F, Division 1, or Group M occupancy that immediately abuts a public sidewalk measured at the sidewalk level for each story that abuts a public sidewalk.

The Display Perimeter is used for a special calculation of window area in the standard design building as explained in Sections 3.2.2 of the state's *Nonresidential Manual*. Refer also to the definition of Exterior Wall in the Glossary of the *Nonresidential Manual*. If you specify Display Perimeter, the maximum fenestration area in the standard design is equal to the greater of either the product of the length of the display perimeter times 6 ft in height or 40% of gross wall area.

Range & Units:

Imperial (US): 0.0 - 99,999 feet
SI (Metric): 0.0 - 30,479.7 meters

Display Perimeter (West)

Enter the West orientation length, in feet, of an exterior wall in a Group B, Group F, Division 1, or Group M occupancy that immediately abuts a public sidewalk measured at the sidewalk level for each story that abuts a public sidewalk.
The Display Perimeter is used for a special calculation of window area in the standard design building as explained in Sections 3.2.2 of the state's *Nonresidential Manual*. Refer also to the definition of Exterior Wall in the Glossary of the *Nonresidential Manual*. The maximum fenestration in a west-facing wall is 40% of the west-facing wall area. If you specify Display Perimeter, the maximum fenestration area in the standard design is equal to the greater of either the product of the length of the display perimeter times 6 ft in height or 40% of gross wall area.
Range & Units:

Imperial (US): 0.0 - 99,999 feet
SI (Metric): 0.0 - 30,479.7 meters

Lighting Tab

Choose one from each of the two groups of choices on this tab: Standard Lighting, to determine the lighting level used in the Standard (Budget) calculation; and Proposed Lighting, to determine the lighting level in the Proposed (Actual) calculation. The default settings use the Standard lighting level based upon the selected occupancy type in the General Tab, and the Proposed lighting calculated from the Lighting Element entries in the Building Tree.

Standard Lighting

Use Standard LPD

Check this item when using the Complete Building or Area Category method of lighting compliance. The program automatically determines the LPD value to be used in the Standard (Budget) Energy calculation. This is the most common selection.

Use Calculated Tailored LPD

If lighting is to be modeled using the Tailored method, check this item. The program calculates the amount of allowed lighting using the Tailored Method, and sets the Standard (Budget) Lighting Energy to the Allowed Tailored LPD, shown to the right.

User Input LPD (Area Category)

If you are modeling a building for which allowed lighting levels have already been determined via the Area Category Method (i.e., allowed lighting levels have been determined by another lighting consultant) check this box and enter the allowed LPD in the User Input LPD box.

Range & Units:

Imperial (US): 0.000 - 99.000 W/ft²
SI (Metric): 0.00 - 1,065.24 W/m²

Proposed Lighting

Use Standard LPD (No Plans)

When no lighting plans or specifications are submitted for permit, check this item.

Use Installed LPD

When the Proposed (Actual) Energy calculation will be based on the light fixtures as input in the Building Tree, check this item. The installed LPD (including control credits) is shown to the right.

User Input LPD

If you are modeling a building for which installed lighting levels have already been determined (e.g., installed lighting levels have been calculated by another lighting consultant), check this box and enter the actual LPD in the User Input LPD box. You may also use this input to quickly test the effects various lighting levels have on the building's overall energy performance.

Range & Units:

Imperial (US): 0.0 - 99.000 W/ft²

SI (Metric): 0.00 - 1,065.24 W/m²

Lighting Type

Select the lighting type and fixture location from the drop-down list. The choices are:

- ☐ Incandescent
- ☐ Recessed Fluorescent
- ☐ Suspended Fluorescent
- ☐ Rec Fluor Return Vent
- ☐ Rec Fluor Ret/Sup Vent

Lighting Heat to Zone

If a portion of the lighting heat is designed to go to the return air rather than the zone, enter the fraction of heat from the lighting which goes to the zone, as a percent. You may only use this field when Recessed Fluorescent, Return Vent or Recessed Fluorescent, Return/Supply Vent fixture types are specified.

Range & Units: 0 - 100%

Mechanical Tab

Zone Level Mechanical System Data

Zonal System

Click in this multi-edit box to select a zonal system from the Zonal Library.

Zonal Multiplier

Enter the number of identical zonal systems, including VAV boxes or Fans, in the Zone.

Range & Units: 1 - 99 (units N/A)

Demand Control Ventilation Check this box if the zone has demand control ventilation (DCV). DCV systems vary the amount of ventilation air depending on the amount of carbon dioxide detected in the space. The standards require DCV systems to use CO2 sensors, and do not allow VOC or other indoor air quality sensors to meet the requirement. The following text is an excerpt from the Section 4.3.7 of the Nonresidential Manual. Refer to that section for additional details on DCV system requirements.

The Standards require the use of DCV systems for spaces with all of the following characteristics:

1. Served by single zone units with any controls or multiple zone systems with Direct Digital Controls (DDC) to the zone level, and
2. Have a design occupancy of 40 ft²/person or smaller (for areas without fixed seating where the design density for egress purposes in the CBC is 40 ft²/person or smaller), and
3. Has an air economizer

There are four exceptions to this requirement:

1. The following spaces are permitted to use DCV but are not required to: classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1000 ft² per §121(b)2B (Table 4-2 and Table 4-3), healthcare facilities and medical buildings, and public areas of social services buildings.
2. Where the space exhaust is greater than the required ventilation rate minus 0.2 cfm/ft².
3. DCV devices are not allowed in the following spaces: Spaces that have processes or operations that generate dusts, fumes, mists, vapors, or gases and are not provided with local exhaust ventilation, such as indoor operation of internal combustion engines or areas designated for unvented food service preparation, or beauty salons.
4. Spaces with an area of less than 150 ft², or a design occupancy of less than 10 people per §121(b)2B (Table 4-2 and Table 4-3).

Pipe Length

For Variable Refrigerant Flow systems only. Enter the refrigerant pipe length from the outdoor condensing unit to the indoor unit.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft

SI (Metric): 0.0 - 30,479.6 m

Supply AC (Air Changes) per Hour

Ordinarily this value is set to zero and the program will automatically calculate it from other inputs (e.g., central system supply airflow). If you enter a non-zero value based on the airflow volume (cfm or L/s) per zone, the program uses this air change rate to set the quantity of supply air in the zone.

Range & Units: 0.00 - 20.00 AC/Hr

Supply Air Flowrate

Enter the Supply Air Flowrate. This input is only required for VAV systems which will comply under the Prescriptive Approach.

Ventilation

Ventilation - Use Standard (Area Basis)

The software automatically calculates the mechanical ventilation based upon fixed default values for ventilation rates in both the Standard and Proposed NR T24 Performance computer runs as described in the Section 4.3 of the Nonresidential Manual.

Ventilation - Use Occupancy

If you check the Use Occupancy Basis checkbox, the program uses the Ventilation and Occupant Density values input in the Occupant Tab of the Room element when running the Win/DOE compliance and NR Loads calculations. Otherwise, the software automatically calculates the mechanical ventilation based upon fixed default values for ventilation rates in both the Standard and Proposed NR T24 Performance computer runs as described in the Section 4.3 of the Nonresidential Manual. You may use the method above for modeling the required ventilation rates for some occupancies in LEED calculations.

Ventilation - Use Air Change

Use this option in a case where the outside air design is stated in air changes per hour for a specific zone. You must enter the number of air changes per hour if you select this option.

Range & Units: 0.00 - 20.00 AC/Hr

[Exhaust Fan]

This is not a Program input. The field displays the airflow per square foot of all exhaust fans in the zone. Enter exhaust fan data in the Exhaust Fan Tab of the Room Element.

Schedules Tab

Load Profiles

Lighting

Click in this multi-edit box to select a lighting schedule from the Schedule Library.

Process Lighting

Click in this multi-edit box to select a process lighting schedule from the Schedule Library.

Infiltration

Click in this multi-edit box to select an infiltration schedule from the Schedule Library.

Occupant

Click in this multi-edit box to select a schedule from the Schedule Library that defines the time and duration of occupancy for the room.

Receptacle

Click in this multi-edit box to select a receptacle schedule from the Schedule Library. The receptacle schedule specifies the percentage of total equipment power that is on at any given hour of the day.

Process

Click in this multi-edit box to select a process schedule from the Schedule Library. The process schedule specifies the percentage of total process load at any given hour of the day.

DHW

Click in this multi-edit box to select a domestic hot water schedule from the Schedule Library.

HVAC Operation

Fan

Click in this multi-edit box to choose a schedule for the fans from the Schedule Library.

Heating

Click in this multi-edit box to select a heating system schedule from the Schedule Library.

Cooling

Click in this multi-edit box to select a cooling system schedule from the Schedule Library.

Room Element

General Tab

Use the Room element of the Building Tree to enter information that describes a particular room or group of rooms in the building. In some cases the entire building may be considered a Room. Double click on the Building Tree's Room element to bring up a tabbed dialog box. Use this dialog box to enter information on general room characteristics, infiltration rates, occupants, equipment and process loads, domestic hot water, exhaust fans, and lighting.

Name

Enter a descriptive name for the room or group of rooms. For example, for residential buildings you may use want to use "Whole House" or "First Floor" as your description. For nonresidential buildings you may want to use "Complete Building" or "Corridor/Support Areas", etc.

Area

Enter the total area for the room or rooms. EnergyPro displays the conditioned floor area in the Building Tree, at the Building, Plant, System and Zone levels. Fly over the element to display the total conditioned floor area for that element.

Range & Units:

Imperial (US): 0.0 - 999,999 ft²

SI (Metric): 0.00 - 92,899.9 m²

Ceiling Height

Enter the average ceiling height for the room or rooms. The program multiplies this value times the floor area to establish the volume of the room.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

Type

- **Existing**

  Existing room that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New room for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the room is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing room to illustrate the room prior to any changes or replacement as well as a New room to describe the room after the alteration.

- **Removed**

  This room will be removed as part of an addition or alteration.

Year Built

If you select an Existing, Altered or Removed Room Type, enter the year the Room was first built. This entry establishes the features that will be used to create the standard design. Refer to Appendix B of the Residential Manual for additional information.

Winter Indoor Temperature

Enter the indoor temperature of the zone during the heating season. The value specified in the Title 24 Standards is 70ºF (21.1□C). If the occupancy is set to Unconditioned and has a non-zero floor area, the heat transfer from an adjacent zone in the NR Loads calculation is defined by this value. That is, instead of using the outside winter design temperature, the program will use the Desired Winter Temperature in calculating the design loads heat flow across the common wall, floor, or ceiling.

Range & Units:

Imperial (US): 0 - 120□F

SI (Metric): -17.8 - 48.9□C

Summer Indoor Temperature

Enter the desired indoor temperature of the zone during the cooling season. The value specified in the *Standards* for residential occupancies is 78ºF (25.6□C). If the occupancy is set to Unconditioned and has a non-zero floor area, the heat transfer to an adjacent zone in the NR Loads calculation is defined by this value. That is, instead of using the outside summer design temperature, the program will use the Desired Summer Temperature in calculating the design loads heat flow across the common wall, floor, or ceiling.

Range & Units:

Imperial (US): 0 - 120□F

SI (Metric): -17.8 - 48.9□C

Installed LPD [Not A Program Input]

The program automatically calculates the Lighting Power Density for the room based on the lighting information entered. Installed LPD does **NOT** include control credits.

Infiltration Tab

Infiltration Rate

Enter the number of times the total volume of air in the room is replaced every hour. A standard infiltration rate for residential buildings is 1.0. For nonresidential buildings, typical values may range from 0.2 to 0.5 air changes per hour. The value you specify will be used in Res Loads, and will be the maximum infiltration level used according to the infiltration schedule in Non Res Loads.

Range & Units: 0.00 - 99.00 AC/Hr

Occupant Tab

Nonresidential

Occupant Density

Enter the area per occupant in the room. If you set the Ventilation Type in the Mechanical Tab of the Zone Element to Use Occupancy Basis, you must use a combination of Occupant Density and Ventilation rate inputs consistent with the minimum ventilation requirements set forth in the Standards. Table 4-3: Minimum Ventilation Requirements in the Nonresidential Manual contains both CBC occupancy loads and ventilation requirements. You may also view the CBC occupant densities in Table 4-2.

Range & Units:

Imperial (US): 1.0 - 99,999.0 ft²/occ

SI (Metric): 0.1 - 9,289.9 m²/occ

Occupant Sensible

Enter the sensible heat gain attributable to each occupant in the room.

Range & Units:

Imperial (US): 0.0 - 99,999.0 Btu/hr-occ

SI (Metric): 0.0 - 29,309.7 W/occ

Occupant Latent

Enter the latent heat gain attributable to each occupant in the room.

Range & Units:

Imperial (US): 0.0 - 99,999.0 Btu/hr-occ

SI (Metric): 0.0 - 29,309.7 W/occ

Ventilation

Enter the ventilation air per occupant. If you set the ventilation type to Use Occupancy, you must use a combination of Occupant Density and Ventilation rate inputs consistent with the minimum mechanical ventilation requirements set forth in the Standards.

Range & Units:

Imperial (US): 0.0 - 99,999.0 cfm/occ

SI (Metric): 0.0 - 47,189.5 L/s/occ

Residential

Number of Kitchens

Enter the number of residential kitchens encompassed by this room. This will be used in your cooling load calculations.
Range & Units: 0.0 - 999.0

Number of Bedrooms

Enter the number of bedrooms. This will be used in your cooling load calculations.
Range & Units: 0.0 - 999.0

Receptacle / Process Tab

(Receptacle) Sensible Heat

Enter the sensible heat gain attributable to the receptacles in the room. Sensible heat is the energy required to change the temperature of completely dry air (0% relative humidity) measured by a dry bulb thermometer. This value is only used for load calculations. Receptacle load for residential and nonresidential compliance calculations (Res T24 Performance and NR T24 Performance) is internally fixed by the program according to occupancy.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

(Receptacle) Latent Heat

Enter the latent heat gain attributable to the receptacles in the room. Latent heat is the energy contained in the moisture (water) in the air. This affects the energy needed to cool the moisture in the air and/or dehumidify the air. This value is only used for load calculations. Receptacle load for residential and nonresidential compliance calculations (Res T24 Performance and NR T24 Performance) is internally fixed by the program according to occupancy.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

(Process Equipment) Sensible Heat

Enter the sensible heat generated by all process equipment in the room in addition to the allotted receptacle load. Process load must be documented on the building plans and detailed in the specifications. Sensible heat is the energy required to change the temperature of completely dry air (0% relative humidity) measured by a dry bulb thermometer. This value is modeled in both the Standard and Proposed designs in the NR T24 Performance calculation.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

(Process Equipment) Latent Heat

Enter the latent heat generated by all process equipment in the room. Latent Heat is the energy contained in the moisture (water) in the air. This affects the energy use needed to cool the moisture in the air and/or dehumidify the air. This value is modeled in both the Standard and Proposed designs in the NR T24 Performance calculation. It must be documented to the satisfaction of the local enforcement agency.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

(Process Lighting) Process LPD

Enter the Lighting Power Density (in watts per square foot) of the lighting fixtures dedicated to illuminating the process. You may use this entry to model the portable lighting load for load calculations.

Domestic Hot Water Tab

Use the entries on this tab to specify the loads associated with Domestic Hot Water.

DHW Internal Gains

Load

Enter the load attributable to domestic hot water.

Range & Units:

Imperial (US): 0.0 - 999,999.0 Btu/hr-occ

SI (Metric): 0.0 - 293,099.7 W/occ

Sensible Heat Gain

Enter the portion, as a decimal, of the DHW load that is sensible heat gain. Sensible heat is the energy required to change the temperature of completely dry air (0% relative humidity) measured by a dry bulb thermometer.

Range & Units: 0.00 - 1.00 (units N/A)

Latent Heat Gain

Enter the portion of the DHW load that is latent heat gain. Latent Heat is the energy contained in the moisture (water) in the air. This affects the energy use needed to cool the moisture in the air and/or dehumidify the air.

Range & Units: 0.00 - 1.00 (units N/A)

Exhaust Fan Tab

Airflow

Enter the rate at which the exhaust fan expels air from the room.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric): 0 - 999,999 L/s

(Fan Motor) Design Power

Enter the power output of the exhaust fan at design conditions.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599.25 kW

(Fan Motor) Drive Efficiency

Enter a value between zero and one hundred (%) to indicate the fan motor drive efficiency reflecting the losses associated with non-direct drive motors. A typical value for a belt-driven fan is 97%.

Range & Units: 0.0 - 100.0% (units N/A)

Fan Multiplier

Enter an integer value to specify the number of identical exhaust fans. If there is no exhaust fan in the room, leave the airflow (above) set to zero.

Range & Units: 1 - 99 (units N/A)

Lighting Tab

Task Data

Activity

Click the Select Activity button to select a category that best describes the room's activity from the *IES Lighting Handbook* list of lighting categories. The application automatically displays the IES Lighting Category for the selected activity.

Task Height

Enter the height above the floor at which the task will be performed.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

Mounting Height

Enter the height above the floor at which the fixtures will be mounted.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

Daylighting

Sidelit Area

Enter the area of the portion of the room lit by sidelighting. If your project also has skylights, be careful not to double-count the daylit area. Refer to Nonresidential Compliance Modeling Topics for more details.

Range & Units:

Imperial (US): 0.0 – 9,999,999 ft²

SI (Metric): 0.00 - 929,030 m²

Skylit Area

Enter the area of the portion of the room lit by skylights. If your project is also sidelit, be careful not to double-count the daylit area. Refer to Nonresidential Compliance Modeling Topics for more details.

Range & Units:

Imperial (US): 0.0 – 9,999,999 ft²

SI (Metric): 0.00 - 929,030 m²

Room Dimensions

Room Dimensions

Enter the dimensions of the task area. Enter the Length and Width **or** the Perimeter. If you enter a value in the Perimeter field, it will override the Length and Width entries.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

Exterior Wall Element

When inputting a proposed building for compliance, every exterior surface or partition of the proposed building must be modeled.

General Tab

Name

Enter a descriptive name of the Wall, e.g., North Wall, Front Wall, etc.

Area

Enter the total gross wall area facing exterior conditions. This includes all glazing areas and door areas. EnergyPro will subtract the area of all openings to obtain the net wall area.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

NOTE: The range for exterior wall area is dynamic. The wall area can never be less than the total window and door area in that wall.

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

Assembly (Existing and/or New)

Click in the appropriate multi-edit box to select a wall construction assembly from the Assembly Library. The wall construction determines the materials, U-Factor, R-Value, absorptivity, roughness, weight and heat capacity of the wall.

Orientation

Enter the orientation of the wall; the value you enter will include all the exterior glazing and doors located on that wall. You may enter the actual orientation in degrees or select an orientation from the drop-down list.

Range & Units: 0 - 360□

See also: Working with the Rotation Input.

Tilt

Specify the angle of the wall relative to the horizontal. A typical vertical wall has a 90º tilt. However, The software will accept values between 60º and 135º. A surface with a tilt of less than 60º is considered a Roof.

Thermal Mass Tab

According to the Residential Manual, Section 5.4, "Thermal mass coupled to conditioned space on one side and exposed to outdoor conditions on the other side is 'exterior' mass." Refer to Residential Compliance Modeling Topics, Thermal Mass and to the Glossary of the Residential Manual for additional modeling information.

Mass Type

Use this drop-down list to select a material type that most closely resembles the mass material you wish to model. For more information on Material Type, see Thermal Mass in the Glossary in Section JA1 of the CEC Reference Appendices. Choices include:

- None
- Adobe
- Concrete, Heavyweight
- Concrete, Lightweight
- Masonry, Partial Grout
- Masonry, Solid Grout
- Wood, Solid Logs
- Wood Cavity Wall

Thickness

Enter the thickness of the material.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Exposed

If a Mass surface is exposed (not covered by cabinets or carpeting, etc.) check this box. Appropriate thermal mass credit will be applied.

Window Element

Use the Window element of the Building Tree to enter the building's glazing and exterior shading information. If there are different glazing types at the same orientation, you may want to name the windows for a distinguishing feature, e.g., East Window, Wood and East Window, Metal, or French Door.

General Tab

Name

Enter a descriptive name for the Window, if desired. If there are different types of glazing at the same orientation, you might want to name the windows for a distinguishing feature, e.g., East Window, Wood and East Windows, Metal, or French Door.

Area

Enter the total area (frame/rough opening) of glazing.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

NOTE: The range for window area is dynamic. The total window and door area in one wall can never be greater than the total exterior wall area.

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the Building Tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Fenestration

Click in the appropriate multi-edit box to select a window assembly from the Fenestration Library.

Exterior Shading Tab

Shading Device

Select an exterior shade type from the available choices. For residential compliance, the program assumes a Standard Bug Screen is in place unless other exterior shading is specified.

The SHGC for the choices are as follows:

- Standard Bug (insect) Screen (Default Exterior Shade, Same as None) = 0.76

- Woven Sunscreen (SC < 0.35) = 0.30
- Louvered Sunscreen = 0.27
- Low Sun Angle Sunscreen = 0.13
- Roll-down Awning = 0.13
- Roll-down Blinds or Slats = 0.13

Refer to Section 3.2.4 in the *Residential Manual* for more detailed information regarding exterior shading. If you select Bug Screen, then there is no requirement that any exterior shade be present at final inspection. If you specify another exterior shade type from the CEC-approved list for solar heat gain reduction credit, it must be present at final inspection.

In nonresidential buildings, the program assumes there is no exterior shading for compliance calculations. The NonRes Loads calculation will use the pre-set value for the other selections.

Overhangs and Sidefins

Window Width

Enter the combined width of all windows with the specified glass and shading combination. Glass Width is needed for glazing which has overhangs or sidefins.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft

SI (Metric): 0.0 - 30,479.7 m

Window Height

Enter the height of all windows with the specified glass and shading combination, in feet. The height is measured from the window sill to its head. Window Height is needed only for glazing that has an overhang. An area weighted average glass height may be used as explained in the *Residential Manual* under "Professional Judgment" in Chapter 5. Window Width is needed for glazing which has overhangs or sidefins.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft

SI (Metric): 0.0 - 30,479.7 m

Overhang

Click in this multi-edit box to select an Overhang assembly from the Overhang Library.

Sidefin

Click in this multi-edit box to select a Sidefin assembly from the Sidefin Library.

Door Element

Name

Enter a descriptive name of the Door. The name is for your information only and does not appear on any program report.

Area

Enter the total area of doors of the specified door type located in the wall.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

NOTE: The range for door area is dynamic. The total door and window area in one wall can never be greater than the total exterior wall area.

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Door

Click in this multi-edit box to select a door assembly from the Assembly Library. The door assembly determines the materials and thermal characteristics of the door(s) in the wall.

NOTE: Doors of more than 50% glass are input as glazing. For a partial glass door (≤ 50%), input only the wood or metal area; input the glazed area, plus a 2 inch border all around, in the Window element; select Door ≤ 50% Glass for the Window Type.

Interior Surface Element

Use the Interior Surface element to model ceilings, walls and floors which serve as demising partitions and other interior partitions. In some cases, modeling interior walls is optional, but it is recommended so that mechanical systems do not appear to the program to be oversized.

Under the nonresidential Standards, demising partitions may **not** be modeled as exterior partitions. Use the Interior Surface element to model demising partitions between conditioned and unconditioned (or indirectly conditioned) spaces. Also use the element to model interior partitions which are solid barriers that separate two adjacent conditioned zones—that is, non-closeable openings that separate one conditioned zone from another.

Under the low-rise residential Standards, demising partitions are modeled as exterior surfaces (i.e., exterior walls, roofs and raised floors). The exception to this is interior surfaces between areas designated living and sleeping zones specially modeled for zonal control credit under the Res T24 Performance compliance method. See Section 4.5.2 in the Residential Manual.

Name

Enter a descriptive name of the Interior Surface.

Area

Enter the total area of the Interior Surface.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Assembly

Click in this multi-edit box to select a construction assembly for the surface from the Assembly Library.

For zonal control credit using Res T24 Performance, you must model interior walls separating living and sleeping zones as Uninsulated Wood Frame Walls, and Nonclosable Openings between zones—no more than 40 ft² (3.7m²)—having a U-Factor of 20. See also Special Topics, Zonal Control or refer to Section 4.5.2 of the *Residential Manual* and Section 5.9 of the *Residential ACM.*

Tilt

Enter the angle of the surface relative to the horizontal. A tilt of 90º is a typical wall, 180º is a typical floor and 0º is a typical roof.

Range & Units: 0 - 180□

Adjacent To

Click the Select button to display the list of rooms from which you can select the Room element adjacent to the Interior Surface.

Floor Element

Name

Enter a descriptive name of the floor.

Area

Enter the total area of the floor.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Floor

Click in this multi-edit box to select a construction for the floor from the Assembly Library. The floor assembly determines the materials, U-Factor, R-value, absorptivity, roughness, weight and heat capacity of the floor.

Thermal Mass Tab

Mass Type

Use this drop-down list to select a material type that most closely resembles the mass material you wish to model. For more information on Material Type, see Thermal Mass in the Glossary in Section JA1 of the CEC Reference Appendices.

Thickness

Enter the thickness of the material.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Exposed

If a Mass surface is exposed (not covered by cabinets or carpeting, etc.) check this box. Appropriate thermal mass credit will be applied.

Slab Element

Name

Enter a descriptive name of the Slab-On-Grade. The name is for your information only and does not appear on any program report.

Area

Enter the total area of the Slab-On-Grade. The slab-on-grade area is modeled identically in both the proposed and standard buildings.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Slab

Click in this multi-edit box to select a construction assembly for the Slab-On-Grade from the Assembly Library. For the nonresidential performance calculation, you must use a floor assembly that has 12” (305 mm) of soil (earth) on the outside. The slab-on-grade construction is modeled identically in both the proposed and standard buildings.

Exterior Perimeter

Enter the exterior perimeter of the conditioned Slab-On-Grade.

Range & Units:

Imperial (US): 0.0 - 99,999.0 feet

SI (Metric): 0.0 - 30,479.7 meters

Thermal Mass Tab

Note that this mass only applies to Lowrise Residential Occupancies.

Mass Type

Use this drop-down list to select a material type that most closely resembles the mass material you wish to model. For more information on Material Type, see Thermal Mass in the Glossary in Section JA1 of the CEC Reference Appendices.

Thickness

Enter the thickness of the material.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Exposed

If a Mass surface is exposed (not covered by cabinets or carpeting, etc.) check this box. Appropriate thermal mass credit will be applied.

Underground Wall Element

See Special Topics: Underground Walls and Floors (Residential) and Underground Walls and Floors (Nonresidential).

General Tab

Name

Enter a descriptive name of the Underground Wall.

Area

Enter the total area of the Underground Wall. The underground wall area is modeled identically in both the proposed and standard buildings.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Underground Wall

Click in this multi-edit box to select a construction assembly for the Underground Wall from the Assembly Library. Nonresidential T24 Performance calculations require the Underground Wall assembly to include 12" 305 mm) of soil (earth) on the outside. You must select the assembly from Reference Appendix JA4. The underground wall construction is modeled identically in both the proposed and standard buildings.

Depth Below Grade

Enter the depth below grade the Underground Wall extends. This value is used to take into account the insulating effects of the earth.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Thermal Mass Tab

Note that this mass only applies to Lowrise Residential Occupancies.

Mass Type

Use this drop-down list to select a material type that most closely resembles the mass material you wish to model. For more information on Material Type, see Thermal Mass in the Glossary in Section JA1 of the CEC Reference Appendices.

Thickness

Enter the thickness of the material.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Exposed

If a Mass surface is exposed (not covered by cabinets or carpeting, etc.) check this box. Appropriate thermal mass credit will be applied.

Underground Floor Element

See Special Topics: Underground Walls and Floors (Residential) and Underground Walls and Floors (Nonresidential).

General Tab

Name

Enter a descriptive name of the Underground Floor. The name is for your information only and does not appear on any program report.

Area

Enter the total area of the Underground Floor. The underground floor area is modeled identically in both the proposed and standard buildings.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Underground Floor

Click in this multi-edit box to select a construction assembly for the Underground Floor from the Assembly Library. Nonresidential performance (Win/DOE) calculations require the Underground Wall assembly to include 12” (305 mm) of soil (earth) on the outside. The underground wall construction is modeled identically in both the proposed and standard buildings.

Thermal Mass Tab

Note that this mass only applies to Lowrise Residential Occupancies.

Mass Type

Use this drop-down list to select a material type that most closely resembles the mass material you wish to model. For more information on Material Type, see Thermal Mass in the Glossary in Section JA1 of the CEC Reference Appendices.

Thickness

Enter the thickness of the material.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Exposed

If a Mass surface is exposed (not covered by cabinets or carpeting, etc.) check this box. Appropriate thermal mass credit will be applied.

Roof Element

General Tab

Name

Enter a descriptive name of the Roof. The roof name is for your information only and does not appear on any program report.

Area

Enter the total gross roof area facing conditioned space.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the

surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Roof

Click in this multi-edit box to select a construction assembly for the roof from the Assembly Library. The roof assembly determines the materials, U-Factor, R-value, absorptivity, roughness, weight and heat capacity of the roof.

Orientation

Specify the orientation of the roof as well as all the skylights within it. You may enter the actual orientation in degrees or select the orientation from the drop-down list.

Range & Units: 0 - 360□

Tilt

Specify the angle of the roof relative to the horizontal. Roofs range between horizontal (0º) up to and including a 59º tilt. Any exterior surface with a tilt 60º or greater is considered a wall.

Range & Units: 0 - 59□

Replacing > 50% of the Roof Surface (or >2,000 sqft NonRes or 1,000 sqft Res)

Select this option when either more than 50% of the total roof surface area is being replaced (or for Nonresidential projects more than 2,000 sqft and Residential projects, more than 1,000sqft), whichever is less.

Thermal Mass Tab

Note that this mass only applies to Lowrise Residential Occupancies.

Mass Type

Use this drop-down list to select a material type that most closely resembles the mass material you wish to model. For more information on Material Type, see Thermal Mass in the Glossary in Section JA1 of the CEC Reference Appendices.

Thickness

Enter the thickness of the material.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Exposed

If a Mass surface is exposed (not covered by cabinets or carpeting, etc.) check this box. Appropriate thermal mass credit will be applied.

Skylight Element

Use the Skylight element of the Building Tree to enter the building's skylight and exterior shading information.

General Tab

Name

Enter a descriptive name for the Skylight, if desired. If there are different types of skylights, you might want to name them for a distinguishing feature , e.g., Translucent Skylight or Transparent Skylight.

Area

Enter the total area (frame/rough opening) of skylight.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

NOTE: The range for skylight area is dynamic. The total skylight area in one roof can never be greater than the total roof area.

Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the four options a Type that most closely matches your surface.

- **Existing**

  Existing surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

  New surface for new construction or being added as part of an addition.

- **Altered**

  Select Altered if the surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to create an Existing surface to illustrate the surface prior to any changes or replacement as well as a New surface to describe the surface after the alteration.

- **Removed**

  This surface will be removed as part of an addition or alteration.

(Existing and/or New) Fenestration

Click in the appropriate multi-edit box to select a window assembly from the Fenestration Library.

Skylight Type

The Nonresidential Standards apply different U-factor and SHGC requirements depending on the type of skylight. Select either a glass skylight, with or without roof curb, or a plastic skylight.

Exterior Shading Tab

Shading device

Select an exterior shade type from the available choices. The default assumption is None unless an exterior shade is specified.

The SHGC for the choices are as follows:

- None (Default for skylights)
- Bug Screen
- Woven Sunscreen (SC < 0.35)
- Louvered Sunscreen
- Low Sun Angle Sunscreen
- Roll-down Awning
- Roll-down Blinds or Slats

Refer to Shading in the Glossary of the *Residential Manual* for more detailed information regarding exterior shading. If you specify an exterior shade type from the CEC-approved list for solar heat gain reduction credit, it must be present at final inspection. In nonresidential buildings, the program assumes there is no exterior shading for compliance calculations. Loads calculations will use the pre-set SHGC value for all other selections.

Daylighting Tab

Skylight Well

Reflectance

Enter the reflectance of the walls of the skylight well. Used in the daylight effectiveness calculation for the well. A value of 1.0 would indicate a perfectly reflecting surface.

Range & Units: 0.10 - 1.00 (units: N/A)

Height

Enter the height of the skylight well. Used to determine the overall well effectiveness in daylighting calculations.

Range & Units:

Imperial (US): 0.0 – 999.0 ft²
SI (Metric): 0.0 – 304.5 m²

Width

Enter the width of the skylight well. Used to determine the overall well effectiveness in daylighting calculations.

Range & Units:

Imperial (US): 0.0 – 999.0 ft²
SI (Metric): 0.0 – 304.5 m²

Length

Enter the length of the skylight well. Used to determine the overall well effectiveness in daylighting calculations.

Range & Units:

Imperial (US): 0.0 – 999.0 ft²
SI (Metric): 0.0 – 304.5 m²

Lighting Element

Name

Enter a descriptive name of the fixture(s).

Luminaire

Click in this multi-edit box to select a lamp/fixture combination from the Lighting Library. The name and wattage of the selected light fixture will appear on the Certificate of Compliance, Form LTG-1 (Part 2 of 2). The program calculates the installed LPD based on the Fixture Types, the number of fixtures and the floor area of the room.

It is important that you either select specific light fixtures for all zones under consideration or that you do not specify any light fixtures, but instead select the Override with Modeled LPD input from the Zone Element, Lighting Tab.

Multiplier

Enter the number of identical fixtures of the selected type. If the fixture selected is a track light, use this input to specify the number of linear feet in the track light rather than the number of fixtures.

Range & Units: 0 - 99,999 (units N/A)

Reference Code

Enter a code that identifies each light fixture type on the Certificate of Compliance, Lighting Forms. The reference code usually corresponds to the codes specified on the building light fixture schedule from the plans or specifications.

Control (Indoor Lighting Only)

Select a Lighting Control option from the drop-down list for varying levels of compliance credit. The lighting credit is applied only to the selected fixtures. For more information on the control options, refer to Table 146-C in the Standards and Section 5.5.4 of the *Nonresidential Manual*. If you select any of the daylighting controls, you must first calculate the credit that the fixture is eligible to receive using the criteria listed in the Standards, Table 146C. Controls must be installed on all fixtures specified in this element. You must provide supporting documentation for lighting control credits.

Task Element

Name

Enter a descriptive name of the Task.

Type

Use the Type drop down list to either select the “Task” or a Display (Wall, Floor, Ornamental, or Very Valuable) lighting category. Selecting Task enables the Select Activity button to select a specific task activity as described in the “Activity” entry. Selecting a Display type enables the Tailored Method entries below. Refer to the Nonresidential Manual for additional details.

Activity

Click the **Select Activity** button to select a category that best describes the area’s activity from the list of lighting categories from the *IES Lighting Handbook*. EnergyPro will display the category name and IES Category identifier.

Area

Enter the area of the task.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Wall Length

Enter the wall length associated with wall displays.

Range & Units:

Imperial (US): 0.0 - 999,999.0 feet

SI (Metric): 0.0 - 30,479.7 meters

Mounting Height

Enter the height above the floor at which the fixtures will be mounted.

Range & Units:

Imperial (US): 0.0 - 999.0 feet

SI (Metric): 0.0 - 304.5 meters

Task Lighting

NOTE: Insert the light fixtures specifically associated with each task by right-clicking on the Task element and selecting Add Lighting to create a new Lighting Element.

Interior Thermal Mass Element

According to the Residential Manual, Section 5.4, "Thermal mass is considered 'interior' if all of its surface area, such as both sides of a masonry partition are exposed to conditioned space." Refer to Residential Compliance Modeling Topics, Thermal Mass and to the Glossary of the Residential Manual for additional modeling information. The software automatically calculates the thermal mass from a slab-on-grade- do not enter it here.

Name

Enter a descriptive name of the Interior Mass.

Area

Enter the area of the Interior Mass.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

Mass Type

Use this drop-down list to select a material type that most closely resembles the mass material you wish to model. For more information on Material Type, see Thermal Mass in the Glossary in Section JA1 of the CEC Reference Appendices.

Thickness

Enter the thickness of the material.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

Exposed

If a Mass surface is exposed (not covered by cabinets or carpeting, etc.) check this box. Appropriate thermal mass credit will be applied.

Calculations

Depending on the modules you have installed and the building type, you may perform any of either the residential or nonresidential calculations for a building description file. EnergyPro allows you to perform multiple calculations at one time and view the results for each in the bottom right window pane. Select Calculations from the list in the lower left window pane to display the list of calculations. Place a check in the checkbox adjacent to each calculation you wish to perform and choose the calculation options displayed in the upper right window pane.

Calculations modules include three basic functions: selecting which calculations are to be run (Options), running the calculations (Calculate), displaying calculation results and diagnostic messages (Results),

To access the Calculations functions, select Calculations from the list in the lower left window pane.

Modules

- Res T24 Performance
- Res GreenPoint Rated
- California Whole-House Energy Rating (HERS)
- Res Performance
- Res Loads
- NR T24 Prescriptive
- NR T24 Performance
- NR ASHRAE 90.1 Performance
- NR T24 LEED
- NR Performance
- NR Loads

Options

Related Topics: Results Calculate

Each calculation module allows you to select specific calculation **Options** that identify which calculations to run, the scope of each project, and several other options.

Calculation Options

Residential Calculations:

Res T24 Performance

Res GreenPoint Rated

California Whole-House Home Energy Rating (HERS) Modules

HERS Providers: CHEERS, CalCERTS, CBPCA

Res Performance

Res Loads

Res T24 Performance, Res Performance, and Res Loads calculations are only performed on zones which are designated as low-rise residential occupancies (Single Family or Multi-Family). The software ignores any nonresidential, hotel/motel and high-rise residential occupancies when you select a low-rise residential calculation.

Nonresidential Calculations:

NR T24 Prescriptive

NR T24 Performance

NR T24 LEED

NR ASHRAE 90.1 Performance

NR Performance

NR Loads

Calculate

Related Topics: Results Calculation Options

You may run selected calculations by clicking on the Calculate button in the toolbar. EnergyPro runs all the calculations that have been selected in the Calculations list. When the calculations are complete, all results are displayed in tabbed format in the bottom-right window pane. Each results tab is labeled with the calculation type (e.g., NR T24 Performance).

You must re-calculate each time you make changes to your file to update Results. If you try to view or print reports after changes were made to the file but you did not recalculate, EnergyPro displays a message reminding you to update your results. You may view and print the reports, but they will not include any calculation results. Instead, the report will print a message stating that "Calculated Results Are Not Current".

Results

Related Topics: Calculate Options

EnergyPro displays the most recent calculation results in tabbed format in the lower-right window pane. Each results tab is labeled with the calculation type (e.g., NR T24 Performance). Click on any tab to display the results. In addition, EnergyPro displays the Input Diagnostic messages on a separate tab in the results pane. Input Diagnostics provide guidance at five different levels, ranging from Information to Errors. Double-click on any message in the Diagnostic Tab, Location List Box, and EnergyPro will take you to the source of the message.

You may adjust the results display size on the screen by dragging the upper bar of the results pane up to enlarge the display or down to show only the tabs at the bottom of the screen.

View Results Details

Residential Calculations:

Res T24 Performance

Res GreenPoint Rated Results

HERS Module Results

Res Performance

Res Loads

Nonresidential Calculations:

NR Prescriptive

NR T24 Performance

NR T24 LEED Performance Results

NR ASHRAE 90.1 Performance Results

NR Performance Results

NR Loads

NOTE: The Results function does not perform calculations. If you have made changes to the file, you must recalculate (select Calculate again) to update the results and view or print reports.

Res T24 Performance Calculation

Related Topics: Res T24 Performance Options Res T24 Performance Results

Res T24 Performance is a state-approved residential computer Performance method, also known as an Alternative Calculation Method (ACM) as defined in the Standards, Section 151(d). It is an updated version of the public domain Microcheck calculation that was first developed for 1988 Second Generation Residential Standards.

See Also:

Basis and Capabilities of the Res T24 Performance Calculation

Building Features Modeled by Res T24 Performance

Res T24 Performance Calculation Options

Res T24 Performance Calculation Results

Res T24 Performance Calculation Options

See Also: Res T24 Performance Module, Res T24 Performance Results, and Res T24 Performance Reports

The **Res T24 Performance** calculation is a state-approved alternative compliance method (performance simulation), as described in Chapter 7 of the Residential Manual. ***The building complies when the Proposed Total TDV Energy Use is equal to or less than the Standard Total TDV Energy Budget.***

Compliance Calculations

Run Standard: Runs the Standard Design which sets the energy budget for the residential building as explained in Chapter 5 of the *Residential Manual*.

Run Proposed: Runs the Proposed Design whose energy use is compared to the Standard energy budget as explained in Chapter 5 of the *Residential Manual*.

Scope

Run Four Orientations: Runs the building in all four cardinal orientations. It is selected only when you are showing compliance of a residential unit plan which is to be built in any orientation within the same subdivision.

Domestic Hot Water: Runs residential domestic hot water (DHW) calculations. It is normally selected for all new low-rise residential buildings, and generally not selected with additions or alterations if no new water heater is being installed.

Delete Temporary Files after Simulation is Complete: Check this box to delete all temporary files generated during the simulation. The default setting is to delete the files.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each end use in Microsoft Excel. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

Run Combined Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations, to allow you to test the cumulative impact of adding new energy-saving measures to the project. The Combined Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the previous results in each iteration, thus building an increasingly efficient model. Selected measures (from the Alternatives Tab) are added in the order listed on that tab.

Run Individual Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations that test the impact of adding one individual energy-saving measure to the project at a time. The Individual Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the base case project in each iterative simulation.

Report Source Energy on CF-1R: To calculate the CHERS score for LEED-H (LEED for Homes) check the "Report Source Energy on CF-1R" option. By checking the option, the CF-1R will report the relevant CHERS score for the proposed design.

Measure Financing

The financial data fields are not used in the Residential T24 Performance simulations. These fields are used for CA Home Energy Rating System (HERS) ratings and reports. Refer to HERS Module Calculation Options for additional details regarding the financial fields and calculations.

Interest Rate: Enter the interest rate if the project will be financed. The default value is the most recent monthly average commitment rate published by Freddie Mac.

Number of Years Financed: Enter the number of years that the measure(s) is(are) financed. The default value is 30 years, or the measure life, if less than 30 years.

Income Tax Bracket: Enter the customer's income tax bracket. The default value is 30%, which is the combined federal and state marginal tax rate.

Incentives

EnergyPro will automatically calculate an incentive estimate for residential projects participating in the 2010-2012 California Advanced Homes program. Select the relevant checkboxes in the Incentives section, and the UTIL-1R (Utility Incentive Worksheet) form from the Residential T24 Performance Reports list to view and print an estimate of the potential incentive.

*Note that incentive estimates produced here are **NOT GUARANTEED**. All projects must meet all program requirements to qualify.*

Meets Energy Star Guidelines: Check the box if the project meets ENERGY STAR for Homes guidelines, and may be eligible to receive an incentive bonus. EnergyPro automatically calculates the bonus amount, and includes the information on the UTIL-1R form.

Certified as a Green Home: Check the checkbox if the project has been certified as a green home by an eligible organization, and may be eligible to receive an incentive bonus. EnergyPro automatically calculates the bonus amount, and includes the information on the UTIL-1R form.

Res T24 Performance Results

See Also: Res T24 Performance Module, Res T24 Performance Reports, and Res T24 Performance Calculation Options

Components of the Res T24 Performance Calculation Results

Calculation: Lists Standard and/or Proposed and/or Alternatives, depending on your selection(s) in Options.

Heating: Lists the annual space heating Time Dependent Valuation (TDV) energy (in kBtu/sf-yr) for the Standard and/or Proposed and/or Alternative designs.

Cooling: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed and/or Alternative designs.

Fans: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed and/or Alternative designs.

Pumps: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed and/or Alternative designs.

DHW: Lists the annual domestic hot water system TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed and/or Alternative designs.

Standard Total: The total predicted (TDV) energy use of the standard design, in TDV kBtu/sqft-yr.

Proposed Total: The total predicted TDV energy use of the proposed building, in TDV kBtu/sqft-yr.

Savings: The energy savings (percent) with respect to the baseline or standard building. If this value is negative, the project does not comply with the Title 24 Standards.

Alternative Measures: When you run alternative measures, the results are shown on one or more lines below the Proposed design results. If you selected both Combined and Individual Alternatives in the Options tab, the results list begins with the Combined Alternatives (cumulative), then lists the Individual Alternatives measure results.

Note that if you mark a building feature or equipment as “New”, EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

To demonstrate compliance, the Proposed Total must be **equal to or less than** the Standard Total. See Chapter 7 in the Residential Manual for a detailed discussion of the Performance Method.

Res T24 Performance Reports

See Also: Res T24 Performance Module, Res T24 Performance Results, and Res T24 Performance Calculation Options

EnergyPro creates reports documenting the project’s energy features, estimated energy usage, and energy costs. See Printing Reports for basic instructions on how to create a report. Select Reports from the options in the lower-left window pane to select the appropriate pages for a report.

EnergyPro Res T24 Performance reports include the following forms:

- Cover Sheet
- Table of Contents
- Form CF-1R – Certificate of Compliance
- Form MF-1R – Mandatory Measures Summary
- HVAC System Heating and Cooling Loads

- Room Load Summary
- Room Heating Peak Loads
- Room Cooling Peak Loads
- Form ECON-1 – Energy Use and Cost Summary
- Form UTIL-1R – Utility Incentive Worksheet

NOTE: All pages of the performance report are automatically stamped by the program with a Run Initiation Time, Run Code, and Date. The local enforcement agency may reject a compliance report if all these values are not the same on every page.

Basis and Capabilities of the Res T24 Performance Calculation

Res T24 Performance is a state-approved residential computer Performance method, also known as an Alternative Calculation Method (ACM) as defined in the Standards, Section 151(d). [The following text explaining computer performance methods is contained in Section 7.0 of the *Residential Manual*.]

Computer methods are computer programs approved by the California Energy Commission as being capable of calculating space conditioning and water heating energy use. The methods *simulate* or *model* the thermal behavior of buildings by calculating heat flows into and out of the various thermal zones of the building. The Warren-Alquist Act calls for the establishment of "performance standards" which predict and compare energy use of buildings. Because of their relative accuracy in analyzing annual space conditioning and water heating energy use of different building conservation features, levels and techniques, computer methods are the basis of performance standards.

A computer method can perform a significant number of calculations to project the interactive thermal effects of many different building components in conjunction with specific outdoor weather conditions. The calculations include:

- ☐ Heat gain and heat loss through walls, roof/ceilings, floors, fenestration and doors
- ☐ Solar gain through fenestration as affected by orientation, fixed shading or operable shading devices
- ☐ Natural ventilation by operable windows and infiltration through cracks and porous surfaces in the building envelope
- ☐ Heat storage effects of different types of thermal mass in buildings with large amounts of mass (e.g., passive solar buildings)
- ☐ Efficiencies of mechanical heating and cooling equipment and duct systems

Computer methods are generally the most detailed and flexible compliance path. The energy performance of a proposed building design can be calculated according to actual building geometry and site placement. Credit for certain conservation features, such as improved duct efficiency or reduced building envelope leakage, cannot be taken in the prescriptive packages, but can be evaluated with an approved computer method.

NOTE: Use of a computer method may require special documentation associated with particular features such as radiant barriers or high thermal mass levels. Refer to the relevant sections in the Residential Manual for additional information. Similarly, compliance credit for features, such as improved duct efficiency or reduced building envelope air leakage, that require diagnostic testing and field verification also require special documentation and processing. See Section 2.5 of the Residential Manual for HERS Field Verification and Diagnostic Testing requirements.

Approval of Computer Methods

For any computer method to be used for compliance with the Standards, the method must first be *approved* by the Commission. Approval involves the demonstration of minimum modeling capabilities and program documentation. The program must be able to:

- ☐ Automatically calculate the ***energy budget*** based upon the ***standard design***
- ☐ Calculate the energy use of the proposed design in accordance with specific fixed and restricted inputs
- ☐ Perform basic water heating calculations
- ☐ Print the appropriate standardized compliance reports.

Modeling capabilities are tested by using the program to calculate the energy use of certain prototype buildings under specific conditions. The results are then compared with the results from the Commission's reference computer method.

The Commission approves the alternative calculation method according to the procedures outlined in Title 24, Part 1, Sections 10-108 through 10-110. The procedures are detailed in the *Residential Alternative Calculation Methods Approval Manual.*

The Commission periodically updates a listing of approved computer programs. This list may be obtained from the Commission's Publications Office, by calling the Energy Hotline at (800) 772-3300, or online at http://www.energy.ca.gov.

Combined Energy Budget: Section 151 (b)

Performance Standards*. A building complies with the performance standard if the combined depletable TDV energy use for water heating Section 151(b)1 and space conditioning Section 151(b)2 is less than or equal to the combined maximum allowable TDV energy use for both water heating and space conditioning, even if the building fails to meet either the water heating or space conditioning budget alone.*

1. ***Water heating budgets****. The water heating budgets for each climate zone shall be the calculated consumption of energy from depletable sources required for water heating in buildings in which the requirements of Section 151(a) and of Section 151(f)8A for systems serving individual dwelling units or of Section 151(f)8C for systems serving multiple dwelling units are met. To determine the water heating budget, use an approved calculation method.*
2. ***Space-conditioning budgets****. The space-conditioning budgets for each climate zone shall be the calculated consumption of energy from depletable sources required for space conditioning in buildings in which the basic requirements of Section 151(a) and the measures in Section 151(f) applicable to Alternative Component Package D are installed. To determine the space-conditioning budget, use an approved calculation method.*
3. ***Multiple heating systems.*** *If a space or a zone is served by more than one heating system, compliance shall be demonstrated with the most TDV energy consuming system serving the space or the zone. For spaces or zones that are served by electric resistance heat in addition to other heating systems, the electric resistance heat shall be deemed to be the most TDV energy consuming system.* ***EXCEPTION to Section 151(b)3:*** *A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kW or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.*

Combined Energy Budget: Space Conditioning and Water Heating Energy Use

Each approved computer method automatically generates an ***energy budget*** by calculating the annual TDV energy use of the ***standard design***, a version of the proposed building incorporating all the conservation features of prescriptive Package D (see Chapter 3). There are two basic components to the energy budget: space conditioning and water heating. Space conditioning is further divided into space heating, space cooling, fans, and pumps.

A building complies with the Standards if the predicted TDV ***energy use*** of the ***proposed design*** is the same or less than the combined annual TDV energy budget for space conditioning and water heating of the standard design. Since the energy budget for the standard design is derived by assuming equal distribution of fenestration area in all four cardinal orientations, the energy budget remains the same regardless of how the actual building is oriented. Variables which affect the energy budget are:

- ☐ Conditioned floor area
- ☐ Conditioned volume
- ☐ Gross roof/ceiling area
- ☐ Gross wall area
- ☐ Slab edge length
- ☐ Conditioned Slab-on-grade area
- ☐ Raised floor area over crawl space
- ☐ Raised floor area over open space
- ☐ Heating system type: Gas or electric
- ☐ Cooling system type: Split or single package
- ☐ Space conditioning distribution system type
- ☐ Climate zone

All other building-related inputs such as area and type of fenestration products, ventilation, HVAC efficiencies and duct efficiencies are automatically fixed in the standard design building according to the Package D requirements and are not accessible for modification by program users.

NOTE: You should not use the Res T24 Performance calculation without having copies of the Standards and Residential Manual at hand for reference.

Building Features Modeled by Res T24 Performance

Res T24 Performance can model the following building features associated with energy use:

- ☐ Roof/ceiling assemblies
- ☐ Wall assemblies
- ☐ Doors assemblies and area
- ☐ Raised floor assemblies
- ☐ Slab-on-grade floor and slab edge insulation
- ☐ Fenestration area, U-Factor, solar heat gain coefficient, interior/exterior shading devices, overhangs, sidefins
- ☐ Thermal mass area, interior and exterior
- ☐ Heating and cooling equipment and ducting
- ☐ Heating and cooling zonal controls
- ☐ Mechanical Ventilation
- Evaporative cooling
- ☐ Water heaters
- ☐ Water heating distribution system
- ☐ Solar collectors
- ☐ Wood stove boiler

GreenPoint Rated Module

GreenPoint Rated is a residential green building rating system developed by Build It Green. The GreenPoint Rated system can be used for single family and multifamily new construction projects, as well as existing homes. The homes must meet specific requirements in five categories (Resource Conservation, Indoor Air Quality, Water Conservation, Energy, and Community) and meet all other requirements to earn the GreenPoint Rated label. The GreenPoint Rated label also provides a numerical score to allow one to compare the environmental performance of different homes.

See Also: GreenPoint Rated Calculation Options and GreenPoint Rated Results

GreenPoint Rated Results

Components of the Res GreenPoint Rated Calculation Results

Calculation: Lists CHERS Standard, GPR Standard, Rated Home, and possibly Alternative Energy Measures, depending on your selections in the Options Tab.

Heating: Lists the annual space heating Time Dependent Valuation (TDV) energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

Cooling: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

Interior Lights: Lists the annual interior lighting TDV energy (in kBtu/sf-yr) for the CHERS Standard and/or Rated Home designs.

Exterior Lights: Lists the annual exterior lighting TDV energy (in kBtu/sf-yr) for the CHERS Standard and/or Rated Home designs.

Appliances: Lists the annual appliances TDV energy (in kBtu/sf-yr) for the CHERS Standard and/or Rated Home designs.

Miscellaneous: Lists the annual miscellaneous TDV energy usage (in kBtu/sf-yr) for each design.

Renewables: Lists the annual TDV energy (in kBtu/sf-yr) generated by the renewable system for the CHERS Standard and/or Rated Home designs (subtracted from the total TDV energy use).

Fans: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

Pumps: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

DHW: Lists the annual domestic hot water system TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

Total: The total predicted (TDV) energy use of the CHERS and GPR Standard designs, the Rated Home Design, and each Alternative Measure design, in TDV kBtu/sqft-yr. A new home must exceed Title 24 by at least 15% (and meet ALL other requirements) to be eligible for GreenPoint Rated certification.

Points: Lists the number of GreenPoints for the Rated Home and each design alternative earned in the Energy category. A new home must earn at least 30 points in the Energy category (and meet ALL other requirements) to be eligible for GreenPoint Rated certification.

HERS Index: The HERS Index Score for the CHERS Standard (always 100), and the Rated Home.

GreenPoint Rated Calculation Options

GreenPoint Rated Module GreenPoint Rated Results

Delete Temporary Files after Simulation is Complete: Check this box to delete all temporary files generated during the simulation. The default setting is to delete the files.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each end use in Microsoft Excel. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

Run Combined Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations, to allow you to test the cumulative impact of adding new energy-saving measures to the project. The Combined Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the previous simulation in each iteration, thus building an increasingly efficient model. Selected measures (from the Alternatives Tab) are added in the order listed on that tab.

Run Individual Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations that test the impact of adding one individual energy-saving measure to the project at a time. The Individual Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the base case project in each iterative simulation.

Note that if you mark a building feature or equipment as "New", EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

Measure Financing

The financial data fields are not used in the GreenPoint Rated simulations. These fields are used for CA Home Energy Rating System (HERS) ratings and reports. Refer to HERS Module Calculation Options for additional details regarding the financial fields and calculations.

Interest Rate: Enter the interest rate if the project will be financed. The default value is the most recent monthly average commitment rate published by Freddie Mac.

Number of Years Financed: Enter the number of years that the measure(s) is(are) financed. The default value is 30 years, or the measure life, if less than 30 years.

Income Tax Bracket: Enter the customer's income tax bracket. The default value is 30%, which is the combined federal and state marginal tax rate.

See Also: HERS Results

Home Energy Rating System (HERS) Modules

HERS Providers: CHEERS, CalCERTS, CBPCA

HERS Results HERS Calculation Options

EnergyPro includes HERS rating calculation modules, one for each HERS Provider, based on the Res T24 Performance module and the CEC HERS regulations. HERS rating software approval is required as part of the certification process for each HERS Provider. HERS calculations performed by EnergyPro provide the information required by each HERS Provider to produce a HERS Rating Certificate for a CA Whole-House

Home Energy Rating and/or a HERS Audit Certificate for a CA Home Energy Audit. The three modules all produce the same HERS Index results.

In addition to the Rating Certificate, each HERS report must also contain a report that provides recommendations to improve the energy efficiency of the home. In addition, each report must contain an analysis of the home's energy consumption and cost, and a summary of the data inputs used to develop the reports.

To produce the actual Rating Certificate and HERS Report, you must export the detailed file data from EnergyPro and upload it to the proper HERS Provider for processing.

See Also: Basis and Capabilities of the HERS Calculations

Basis and Capabilities of the HERS Calculations

HERS Providers: CHEERS, CalCERTS, CBPCA

California HERS Index Components

The HERS Rating is a method of providing a score that represents the relative energy efficiency of a residential building as compared to a Reference Home. The HERS Technical Manual defines the CA HERS Index as "…the ratio of the Time Dependent Value (TDV) energy of the rated home to the TDV energy of the reference home…".

The HERS Index ranges from 0 – 250. A score of 0 represents a Zero Net Energy home, and a score of 100 represents the reference home, one that just meets the requirements of the 2008 Building Energy Efficiency Standards (Title 24, Part 6). The basis of the building envelope, HVAC, and water heating features of the reference home is prescriptive Package D, which is contained in Section 151(f) of the *2008 Building Energy Efficiency Standards*.

The following paragraphs describing the energy uses included in the CA HERS Index, and the general rules for photovoltaic systems and larger homes are excerpted from the HERS Technical Manual.

> "The TDV energy of the rated home and reference home shall include heating, cooling, and water heating (the traditional energy uses included in Title 24 energy compliance calculations) but also all other interior gas and electric energy for appliances, interior lighting, and miscellaneous use. Energy shall also be included for outdoor lighting that is attached to the building or located in the garage, but all other outdoor energy uses shall be excluded from the California HERS Index. Procedures for calculating the components of energy to be considered in the California HERS Index are described in Chapter 4.
>
> The TDV energy of the rated home and the reference home shall not include ancillary energy such as swimming pools and associated heaters and pumps, spas, barns, sheds, well pumps, grinder pumps, and lighted tennis courts.
>
> When the rated house has a photovoltaic (PV) system or other on-site renewable generation, the California HERS Index shall be calculated both with and without the on-site generation. The HERS Index without including the on-site generation shall be calculated using Equation 1 and setting the TDV_{PV} value to zero.
>
> If the conditioned floor area of the rated home is larger than 2,500 square feet (ft^2), the TDV energy of the reference home shall be based on a 2,500 ft^2 home."

Although the HERS Index is limited to certain energy using equipment and appliances, the HERS Report also contains an energy consumption and bill analysis and recommendations for cost-effective improvements, in addition to the Rating itself. Most homes contain energy-using equipment that is not included in the HERS Index, but is included in the other HERS Report calculations, including pools, spas, well pumps, landscape lighting, as well as other ancillary uses.

EnergyPro includes all data entry fields required to produce a HERS Rating and Report. Most of the fields specific to HERS Ratings are located in the HERS Tab of the Building Element.

CA HERS Rating Software Requirements

The following text explaining HERS rating software requirements is contained in Section 1.1 of the CEC HERS Technical Manual.

HERS rating software shall meet the minimum and optional modeling capabilities specified in Chapters 4 and 5 of the *2008 Residential ACM Approval Manual* (Energy Commission Publication CEC 400-2008-002-CMF). The minimum modeling capabilities are summarized below:

- Conduction gains and losses through opaque and fenestration surfaces
- Slab edge gains and losses
- Infiltration gains and losses
- Solar gains through glazing including the effects of internal shading devices
- Natural ventilation cooling
- Mechanical ventilation for Indoor Air Quality (IAQ)
- Thermal mass effects to dampen temperature swings
- Space conditioning equipment efficiency and distribution systems
- Water heating equipment efficiency and distribution systems
- Building additions
- Attic modeling (Unconditioned Zone Model - UZM)
- Maximum cooling capacity
- Raised floors with automatically operated crawl space vents
- Zonal control or multi-zone modeling of the sleeping and living areas of the house
- Attached sunspaces for collection and possible storage of heat for transfer to the main house
- Exterior mass walls
- Overhangs and sidefin shading
- Combined hydronic space and water heating
- Building alterations
- Solar water heating
- Gas-fired and absorption cooling
- Evaporatively-cooled condensing units
- Ice storage air conditioner
- Evaporative coolers
- Photovoltaic performance modeling

HERS Module Results (Res CHEERS, Res CalCERTS, Res CBPCA)

HERS Providers: CHEERS CalCERTS CBPCA

HERS Modules HERS Options Exporting Results

Components of the HERS Calculation Results

Calculation: Lists CHERS Standard and Rated Home, and possibly Alternative Energy Measures, depending on your selections in the Options Tab.

Heating: Lists the annual space heating Time Dependent Valuation (TDV) energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

Cooling: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

Interior Lighting: Lists the annual interior lighting TDV energy (in kBtu/sf-yr) for the CHERS Standard and/or Rated Home designs.

Exterior Lighting: Lists the annual exterior lighting TDV energy (in kBtu/sf-yr) for the CHERS Standard and/or Rated Home designs.

Appliances: Lists the annual appliances TDV energy (in kBtu/sf-yr) for the CHERS Standard and/or Rated Home designs.

Miscellaneous: Lists the annual miscellaneous TDV energy usage (in kBtu/sf-yr) for each design.

Renewables: Lists the annual TDV energy (in kBtu/sf-yr) generated by the renewable system for the CHERS Standard and/or Rated Home designs (subtracted from the total TDV energy use).

Fans: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

DHW Pump: Lists the annual space cooling TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

DHW: Lists the annual domestic hot water system TDV energy (in kBtu/sf-yr) for the Standard and/or Proposed designs.

CHERS Standard Total: The total predicted (TDV) energy use of the CHERS standard design, in TDV kBtu/sqft-yr.

Rated Home Total: The total predicted TDV energy use of the Rated Home, in TDV kBtu/sqft-yr.

HERS Index: The HERS Index Score for the CHERS Standard (always 100), and the Rated Home.

Savings: The annual energy cost savings ($) with respect to the Rated Home (shown only when you run alternative measures). If you selected both Combined and Individual Alternatives in the Options tab, the results list begins with the Combined Alternatives (cumulative savings), then lists the individual measure savings.

HERS Module Calculation Options

HERS Providers: CHEERS, CalCERTS, CBPCA

The HERS Rating calculation requirements are documented in detail in the CA Home Energy Rating System Technical Manual published by the CA Energy Commission. Refer to HERS Modules, Basis and Capabilities of the HERS Calculations, or the CEC HERS Technical Manual for additional details regarding HERS Ratings.

Delete Temporary Files after Simulation is Complete: Check this box to delete all temporary files generated during the simulation. The default setting is to delete the files.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each end use in Microsoft Excel. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

Run Combined Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations, to allow you to test the cumulative impact of adding new energy-saving measures to the project. The Combined Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the previous simulation in each iteration, thus building an increasingly efficient model. Selected measures (from the Alternatives Tab) are added in the order specified in Section 6.2 of the HERS Technical Manual.

Run Individual Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations that test the impact of adding one individual energy-saving measure to the project at a time. The Individual Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the base case project in each iterative simulation. Selected measures (from the Alternatives Tab) are added in the order listed on that tab.

Note that if you mark a building feature or equipment as "New", EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

Measure Financing

The financial data fields are not used in the Residential T24 Performance simulations. These fields are used for CA Home Energy Rating System (HERS) Rating Reports. Each HERS Report includes a set of recommendations for cost-effective energy efficiency improvements. Measure cost-effectiveness is determined when the first year energy cost savings is equal to or greater than the additional annual mortgage payments with consideration of tax benefits.

The recommendations may be created using either the HERS Standard Approach or a Custom Approach. The Standard Approach limits the measures analyzed, and uses default assumptions of measure cost, savings, and financial information. The Custom Approach allows the Rater to account for unusual situations, usage patterns or additional equipment. In addition, Custom Approach cost-effectiveness calculations allow you to use cost data based on bids a homeowner may have already received. You may also specify different criteria to identify different packages of measures, including using a fixed budget for investments, minimum performance level, and/or customer-identified measures. Refer to Chapter 6 of the HERS Technical Manual for additional details regarding the rules for generating the recommendations list using both the Standard and Custom approaches.

Interest Rate: Enter the interest rate if the project will be financed. The default value is the most recent monthly average commitment rate published by Freddie Mac.

Number of Years Financed: Enter the number of years that the measure(s) is(are) financed. The default value is 30 years, or the measure life, if less than 30 years.

Income Tax Bracket: Enter the customer's income tax bracket. The default value is 30%, which is the combined federal and state marginal tax rate.

See Also: HERS Results and Exporting Results

Res Performance Calculation Module

See Also: Res Performance Calculation Options, and Res Performance Results

Use the Res Performance Module to simulate the energy performance of a project that doesn't involve a particular Standard. Res Performance performs an hourly simulation on the building to determine annual energy consumption and energy cost.

The Res Performance simulation includes additional energy end-uses beyond those considered in Title 24, including: interior and exterior lights, appliances, and energy generated by on-site renewable energy systems. You may use the default assumption for interior lighting or enter the interior lighting power density manually in the Lighting Tab of the Zone Element.

Res Performance Calculation Options

See Also: Res Performance Module, and Res Performance Results

Delete Temporary Files after Simulation is Complete: Check this box to delete all temporary files generated during the simulation. The default setting is to delete the files.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each end use in Microsoft Excel. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

Run Combined Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations, to allow you to test the cumulative impact of adding new energy-saving measures to the project. The Combined Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the previous results in each iteration, thus building an increasingly efficient model. Selected measures (from the Alternatives Tab) are added in the order listed on that tab.

Run Individual Alternative Energy Measures: Select this option to instruct EnergyPro to conduct iterative simulations that test the impact of adding one individual energy-saving measure to the project at a time. The Individual Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the base case project in each iterative simulation.

Note that if you mark a building feature or equipment as "New", EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

Measure Financing

The financial data fields are not used in the Residential Performance simulations. These fields are used for CA Home Energy Rating System (HERS) ratings and reports. Refer to HERS Module Calculation Options for additional details regarding the financial fields and calculations.

Interest Rate: Enter the interest rate if the project will be financed. The default value is the most recent monthly average commitment rate published by Freddie Mac.

Number of Years Financed: Enter the number of years that the measure(s) is(are) financed. The default value is 30 years, or the measure life, if less than 30 years.

Income Tax Bracket: Enter the customer's income tax bracket. The default value is 30%, which is the combined federal and state marginal tax rate.

Res Performance Results

See Also: Res Performance Module, and Res Performance Calculation Options

Components of the Res Performance Calculation Results

Calculation: Lists Standard and/or Proposed and/or Alternatives, depending on your selection(s) in Options.

Heating: Lists the annual space heating energy (in kBtu/sf-yr) for the Proposed design.

Cooling: Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design.

Interior Lights: Lists the annual interior lighting energy (in kBtu/sf-yr) for the Proposed design.

Exterior Lights: Lists the annual exterior lighting energy (in kBtu/sf-yr) for the Proposed design.

Appliances: Lists the annual appliances energy (in kBtu/sf-yr) for the Proposed design.

Miscellaneous: Lists the annual miscellaneous energy usage (in kBtu/sf-yr) for each design.

Renewables: Lists the annual energy (in kBtu/sf-yr) generated by the renewable system for the Proposed design (subtracted from the total energy use).

Fans: Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design.

Pumps: Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design.

DHW: Lists the annual domestic hot water system energy (in kBtu/sf-yr) for the Proposed design.

Total: The total predicted energy use of the home, and each Alternative Measure design, in kBtu/sqft-yr.

Alternative Measures: When you run alternative measures, the results are shown on one or more lines below the Proposed Design results. If you selected both Combined and Individual Alternatives in the Options tab, the results list begins with the Combined Alternatives (cumulative), then lists the Individual Alternatives measure results.

Note that if you mark a building feature or equipment as “New”, EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

Res Loads Calculation

Section 150 of the *Standards* describes mandatory features and devices, including the sizing of heating and cooling equipment.

The sizing of residential heating is regulated by the *Uniform Building Code (UBC)* and the *Standards*. The *UBC* requires that the heating system be capable of maintaining a temperature of 70°F (21.1°C) three feet (0.91 meters) above the floor throughout the conditioned space of the building.

Section 150(h) of the *Standards* states that the building design heat loss rate and design heat gain rate shall be determined using a method based on ASHRAE, SMACNA or ACCA Manual J: “For the purpose of sizing the space conditioning (HVAC) system, the indoor design temperatures shall be 70°F (21.1°C) for heating and 75°F (23.9°C) for cooling. Outdoor design conditions shall be selected from Reference Joint Appendix JA2, which is based on data from the ASHRAE Climatic Data for Region X. The outdoor design temperatures for heating shall be no lower than the Heating Winter Median of Extremes values. The outdoor design temperatures for cooling shall be no greater than the 1.0 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.” The software uses the Median of Extremes as the default value.

While documentation of residential load calculations is not a permit requirement, it is recommended. In addition, documentation must be submitted at the request of the local enforcement agency.

Refer directly to ASHRAE publications for further information, including the **ASHRAE *Cooling and Heating Load Calculation Manual*,** which is an especially well-organized explanation of the topic, particularly Chapter 7, “Residential Heating and Cooling Loads.” The manual may be obtained by contacting:

ASHRAE
1791 Tullie Circle, N.E.

Atlanta, GA 30329-2305
Customer Service 1-800-527-4723

The Residential Loads calculation is based on the **ASHRAE *Cooling and Heating Load Calculation Manual*** as applied to each HVAC System specified within the program. There is no hourly analysis of cooling loads (as there is in the Nonresidential Loads calculation), only the use of the listed average hourly solar gain factor (SGF) values based on glazing orientation and cooling load temperature difference (CLTD) values which are not sensitive to the opaque surface being modeled.

For Further Information

For additional details on the Residential Loads method, refer directly to the ASHRAE publications mentioned above. Also see Sections 4.2 and 4.3 in the Residential Manual for discussions of Space Conditioning System Sizing and Space Conditioning System Design.

View ASHRAE Policy Statement

(Res) Loads Options

Winter Design Conditions: Select the winter design conditions to use for the load calculations from the drop-down list. Choices include: Median of Extremes, 2.0% Design Data, and 6.0% Design Data. Median of Extremes is the default value. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982*.

Summer Design Conditions: Select the summer design conditions to use for the load calculations from the drop-down list. Choices include: 0.5%/0.4% Design Data, 1.0% Design Data, and 2.0% Design Data. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982.*

Use Design Wet Bulb (not Mean Coincident): Check the checkbox to use the Design Wet Bulb rather than the Mean Coincident value in the load calculations.

Ignore Exterior Shades in Load Calculations: Check the checkbox if you wish to calculate loads without the effects of any exterior shades.

Design Day for Schedules: Select a day of the week to use as the Design Day for Schedules, or select Ignore to set all to 100%. The program will use the weekly schedules you have selected throughout the building description, using the day of the week you have selected. When the variable is set to Ignore Schedules (use 100%), the program automatically overrides the schedules selected and runs maximum (100% on, 24 hours per day) schedules in all load calculations.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

The **Res Loads** calculation is a computerized version of the residential ASHRAE heating and cooling loads methodology.

Res Loads Results

Components of the Res Loads Calculation Results

System: The name of the Mechanical System serving the Zone(s) selected.

Heating Load: The design block heating load of all the Zones served by the System, in Btu/hr.

Heating Output: The heating output of the mechanical system, in Btu/hr.

Sensible Load: The design block sensible cooling load of all the Zones served by the System, in Btu/hr.

(tons): The design block sensible cooling load of all the Zones served by the System, in tons.

Sensible Output: The cooling output of the mechanical system, in Btu/hr.

(tons): The cooling output of the mechanical system, in tons.

Latent Load: The design block latent cooling load of all the Zones served by the System, in Btu/hr.

Latent Output: The design block latent cooling output of all the Zones served by the System, in Btu/hr.

NR T24 Prescriptive Calculation

Related Topics: NR Prescriptive Options NR Prescriptive Results NR Prescriptive Reports

The **NR Prescriptive** calculation is a computerized version of the Nonresidential Prescriptive Envelope, Indoor Lighting, Mechanical, and Outdoor Lighting methods. The calculation provides a display of key aspects of Envelope, Lighting and Mechanical compliance of the building with the Nonresidential Prescriptive standards. Refer to Chapters 3, 4, 5, and 6 of the Nonresidential Manual for a detailed discussion of the Prescriptive approach.

Envelope

EnergyPro calculates Prescriptive Envelope compliance using the Overall Envelope TDV Approach. Prescriptive Envelope compliance is met when the proposed design TDV energy is equal to or less than the standard design TDV energy.

See the Standards, Section 143 and the Nonresidential Manual, Section 3.7 for additional details.

Indoor Lighting

To comply with the Prescriptive Indoor Lighting requirements, the Proposed installed Watts/square foot must be equal to or less than the Standard Watts/square foot.

The program adds up installed wattage and compares it to the Complete Building or Area Category values selected according to the occupancy type of each zone. Refer to the Standards, Section 146 and to the Nonresidential Manual, Section 5.3 for additional details.

Outdoor Lighting

To comply with the Prescriptive Outdoor Lighting requirements, the proposed lighting power must be equal to or less than the Standard lighting power. The program adds up installed wattage and compares it to the Outdoor Lighting power allowance based on the outdoor activity selected in the Exterior Application Element of the Building Tree. Refer to the Standards, Section 147 and to Section 6 of the Nonresidential Manual for additional details.

Mechanical (HVAC)

To comply with the Prescriptive Mechanical requirements:

- ☐ Proposed Heating output must be equal to or less than the Standard output for each Mechanical System, and the Proposed Cooling output must be equal to or less than the Standard output for each Mechanical System; or,
- ☐ You must demonstrate the equipment selected has the smallest output capacities that can meet the load "within the available options of the desired equipment line" as stated in Section 144(a) of the *Standards*.
- ☐ Air conditioning equipment with cooling capacity greater than 75,000 Btuh (22.0 kW) and 2,500 cfm (1179.8 L/s) may also require an integrated economizer (see the *Nonresidential Manual,* Section 4.5.2).

☐ Fan systems over 25 horsepower (18.7 kW) at design conditions may need to meet specific fan watts/cfm requirements (see the *Nonresidential Manual*, Section 4.6.6).

Heating (Btuh): The Standard value is the design heating load times 1.43, which is the oversizing factor for heating systems generally allowed under the Prescriptive Mechanical standard (with the exception listed above).

Cooling (Btuh): The Standard value is the design cooling load times 1.21, which is the oversizing factor for cooling systems generally allowed under the Prescriptive Mechanical standard (with the exception listed above).

NOTE: There are several special equipment and/or control requirements, as well as exceptions to those requirements, which apply to the Prescriptive Mechanical standards. Carefully review Section 144 of the Standards and Chapter 4 of the Nonresidential Manual to make sure that all applicable Prescriptive Mechanical requirements have been met.

NR T24 Prescriptive Calculation Options

Scope

Envelope	Runs the nonresidential Prescriptive Envelope calculations.
Indoor Lighting	Runs the nonresidential Prescriptive Indoor Lighting calculations using the selected Lighting Method. You may override occupancy designations within the Zone Element of the Building Tree by selecting the Complete Building checkbox and specifying the building type.
Outdoor Lighting	Runs the Outdoor Lighting Calculations as explained in Chapter 6 of the *Nonresidential Manual*
Mechanical	Runs the nonresidential Prescriptive Mechanical calculations.

The **NR T24 Prescriptive** calculation is a computerized version of the Nonresidential Prescriptive Envelope, Lighting, Mechanical, and Outdoor Lighting methods. Refer to Chapters 3, 4, 5, and 6 of the Nonresidential Manual for a detailed discussion of the Prescriptive approach.

NR T24 Prescriptive Reports

The program can print out either prescriptive or performance reports or both. See Printing Reports for basic printing instructions. Using the Report Wizard feature makes it easy to select the appropriate forms to include in your report. Refer to Appendix A in the *Nonresidential Manual* to see sample compliance forms.

Submit only those forms which are appropriate to the category covered by the permit (envelope, lighting and/or HVAC). Within each category print *all* forms except as noted below.

NOTE: If you made changes to the model, but did not re-calculate, the software will display a message reminding you to re-calculate and warning you that the reports will be printed without calculation results if you print.

The Title 24 compliance documentation for the prescriptive approach for envelope, lighting and HVAC includes:

- ☐ Cover Sheet (optional)
- ☐ Table of Contents (optional)
- ☐ Form ENV-1-C Envelope Certificate of Compliance
- ☐ Form ENV-3-C Overall Envelope TDV Approach
- ☐ Form ENV-4-C Minimum Skylight Area Worksheet
- ☐ Form ENV-MM Envelope Mandatory Measures
- ☐ Form LTG-1-C Lighting Certificate of Compliance
- ☐ Form LTG-2-C Lighting Controls Credit Worksheet
- ☐ Form LTG-3-C Indoor Lighting Power Allowance
- ☐ Form LTG-4-C Tailored Method Worksheet
- ☐ Form LTG-MM Lighting Mandatory Measures
- Form OLTG-1-C Certificate of Compliance
- ☐ Form OLTG-2-C Lighting Compliance Summary
- ☐ Form SLTG-1-C Sign Lighting Compliance
- ☐ Form MECH-1-C Certificate of Compliance
- ☐ Form MECH-2-C Air and Water System Requirements
- ☐ Form MECH-3-C Mechanical Ventilation
- ☐ Form MECH-4-C HVAC Misc. Prescriptive Requirements
- ☐ Form MECH-MM Mechanical Mandatory Measures, Parts 1 and 2
- ☐ HVAC System Heating and Cooling Loads Summary (optional)
- ☐ Zone Load Summary
- Room Load Summary (optional)
- ☐ Room Heating Peak Loads (optional)
- ☐ Room Cooling Peak Loads (optional)
- ☐ Room Cooling Coil Loads (optional)

Which Forms Go On the Drawings?

According to Section 10-103 (a)(2) of the state's Administrative Regulations "the [permit] applicant shall file the appropriate Certificate(s) of Compliance on the plans." This means that the permit drawings must include a signed copy of ENV-1-C, LTG-1-C, OLTG-1-C, SLTG-1-C, and MECH-1-C forms, as appropriate for the scope of the project.

NR Prescriptive Results

Envelope

TDV Energy: EnergyPro calculates NR T24 Prescriptive envelope compliance using the Overall Envelope TDV Energy approach. The calculation results display the total TDV energy of the envelope for the standard and/or proposed building design. The project complies with the Title 24 Standards if the proposed building TDV energy is less than the standard building TDV energy.

For further details, see Section 3.1.2 of the Nonresidential Manual.

Lighting

Prescriptive Lighting calculations include up to three separate components depending on the building design: Indoor Conditioned Lighting Power Density (LPD), Indoor Unconditioned LPD, and Outdoor Lighting Power.

NR Prescriptive Lighting calculations results display the total indoor lighting power density in Watts per square foot of the Standard design (the maximum lighting allowed) and the Proposed design for each applicable Indoor Lighting Component. The Proposed LPD must be **equal to or less than** the Standard in each case for the proposed building to meet the Prescriptive lighting requirements. Outdoor Lighting power is displayed for both the standard and proposed designs in Watts.

Indoor and Outdoor lighting must comply with the requirements independently; there are no tradeoffs between the two allowed. Refer to Section 5.3 of the *Nonresidential Manual* for additional information regarding the Prescriptive lighting requirements, and Section 6.4 for additional information regarding Outdoor Lighting Power compliance.

Mechanical

Heating (Btuh): For each System listed, the Standard design heating load is the maximum allowed, and the Proposed installed heating capacity must **be equal to or less than** the Standard for each System for the building to meet the Prescriptive Mechanical requirements.

Cooling (Btuh): For each System listed, the Standard design cooling load is the maximum allowed, and the Proposed installed cooling capacity must be **equal to or less than** the Standard for each System for the building to meet the Prescriptive Mechanical requirements.

Fan Power (W/cfm): For each System listed, the Standard design fan power (in watts per cfm) is the maximum allowed, and the Proposed installed fan power must be **equal to or less than** the Standard for each System for the building to meet the Prescriptive Mechanical requirements.

For further details, see Section 4.1.3 of the *Nonresidential Manual* or Section 144 of the *Standards*.

NR T24 Performance Calculation (for Title 24 Compliance)

Related Topics: NR T24 Performance Options NR T24 Performance Results NR T24 Performance Reports

The program performs a NR T24 Performance compliance analysis of the building when you select the NR T24 Performance calculation, check the **Run Standard** and **Run Proposed** calculation options, and specify the Scope using the **Envelope, Lighting, Mechanical and/or DHW** checkboxes.

If the typical options are selected, the program runs a full annual compliance simulation on both the Standard Design and the Proposed Design. As explained in Chapter 9 of the *Nonresidential Manual*, the Standard Design TDV Energy Budget sets the standard for the building. It is a custom energy budget because it is generated on a case-by-case basis, and becomes the goal for energy efficiency that the Proposed building must meet.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

The Standard Design

The Standard Design is generated automatically by the program based on the characteristics of the Proposed Design. The Standard Design:

- ☐ Has exactly the same physical size and shape as the Proposed Design;
- ☐ Has the same occupancy schedules and zoning as the Proposed Design;
- ☐ Has the prescriptive assembly U-Factors and prescriptive glazing U-Factors and solar heat gain coefficients, based on climate zone;
- ☐ Has the prescriptive lighting allotment based on occupancy or task requirements;
- ☐ Has the mandatory ventilation rates by occupancy;
- ☐ Has a mechanical system appropriate for the type installed in the proposed design; and,
- ☐ Has a system size which is appropriate for the design heating and cooling loads of the Standard Design.

Full details on the assumptions used to generate the Standard Design building are contained in the *Nonresidential Alternative Calculation Method (ACM) Manual Approval Method for the 2008 Building Energy Efficiency Standards*.

Because the Standard Design is based upon many of the characteristics of the Proposed Design, the energy budget always changes when any change is made to the proposed building design. If you change an attribute of the building, you must re-calculate.

See Also:

Basis and Capabilities of NR T24 Performance

Building Features Modeled by NR T24 Performance

Energy Conservation Measures Modeled by NR T24 Performance for Compliance with Title 24

Noncompliance Energy Analysis

- Using NR Performance for Noncompliance Energy Analysis
- Using NR Performance as a Doe-2 BDL & Report Generator
- Default DOE-2.1E Reports

NR T24 Performance Options

Calculations

Run Standard: Runs the Standard Design which sets the energy Performance budget for the building as explained in Section 9 of the Nonresidential Manual.

Run Proposed: Runs the Proposed Design whose energy use is compared with the energy Performance budget as explained in Section 9 of the Nonresidential Manual.

Scope: Sets the project Scope. Check Envelope, Lighting, Mechanical and/or Domestic Hot Water to set the scope of the analysis. Include all project components for which a permit is desired.

Delete Temporary Files After Simulation is Complete: Deletes the DOE-2.1E files once the simulation is complete. Only the final results are saved in the software file. Do not check this box if you wish to keep a copy of the DOE-2 input (BDL) or output (SIM) files, or if you need to troubleshoot a file that doesn't run properly.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

Reports: You may select specific DOE-2 output reports in the Utility Tab of the Building Element. If you do not make any selection, the DOE-2 output will contain only the default DOE-2 reports.

WARNING: In order to have any DOE-2 reports available, you must instruct the software to save the DOE files after the run. Remove the check mark from the Delete DOE Files After Run checkbox (see above).

The NR T24 Performance calculation is a Title 24 compliance version of the U. S. Department of Energy's DOE-2.1E program, which is a comprehensive hourly building energy simulation program.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

NOTE: If you need to review the intermediate NR T24 Performance files to identify a program error, look at the .BDL file first; then look at the .SIM file. This can be done with a word processor.

NR T24 Performance Results

When the calculation is complete, the display summarizes the results of the NR T24 Performance calculation according to category of energy end use. The NR T24 Performance Annual TDV Energy Use Estimate (kBtu/sqft-yr) is shown for both the **Standard** Design Total energy budget, and the **Proposed** Building Total energy use.

For a building to comply, the **Proposed** Total TDV energy use must be equal to or less than the **Standard** Total TDV energy budget.

All calculation results displayed are for the building as a whole. Categories of TDV energy end use are as follows:

Heating: Annual TDV energy used for space heating

Cooling: Annual TDV energy used for space cooling

Lighting: Annual TDV energy used for electric lights

Process Lighting: Annual TDV energy used in process lighting input within the program

Receptacle: Annual TDV energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.

Fans: Annual TDV energy used for fans moving conditioned air

Heat Rejection: Annual TDV energy used for cooling tower operation

Pumps: Annual TDV energy used pumps for hot water, chilled water, and condenser water piping systems

Process: Annual TDV energy used in process loads input within the program

DHW: Annual TDV energy used for domestic (service) hot water

A discussion of the various components of energy use in typical nonresidential buildings is contained in Chapter 1 of the *Nonresidential Manual*.

NOTE: You should not attempt to use NR T24 Performance without having a copy of the latest Standards and Nonresidential Manual available from the California Energy Commission Publications Unit. This software's on-screen Help documentation refers to topics explained in detail in both documents. The state's ACM Manual contains detailed information on the rules which define the Standard Design.

The simulation time required to complete a NR T24 Performance compliance analysis, which is really two full DOE-2 hourly simulations, depends on such variables as:

- ☐ The complexity of the building input file (especially the number of zones and systems)
- ☐ The type and speed of the computer's CPU
- ☐ The amount of the computer's available random access memory (RAM)

NR T24 Performance Compliance Reports

The program can print either prescriptive or performance Title 24 reports, or both. See Printing Reports for basic instructions. Select Reports from the options in the lower-left window pane to select the appropriate pages for a report. Refer to Appendix A in the *Nonresidential Manual* to see sample compliance forms.

Submit only those forms which are appropriate to the category covered by the permit (envelope, lighting and/or HVAC). Within each category print *all* forms except as noted below.

NOTE: The program will print a NR Title 24 performance compliance report for a building that does not meet the Standards, however, it will stamp the PERF-1 Form with a message stating "Building Does Not Comply". Also, it will not print a report if changes were made but no re-calculation was run. EnergyPro displays a message on-screen noting that the calculations are out of date and the report cannot be printed.

The software compliance documentation for the NR T24 Performance approach for envelope, lighting, and HVAC includes:

- ☐ Cover Sheet (optional)
- ☐ Table of Contents (optional)

Nonresidential Performance Title 24 Forms

- ☐ Form PERF-1 Performance Certificate of Compliance, Parts 1, 2, and 3
- ☐ Form ENV-1-C Certificate of Compliance
- ☐ Form LTG-1-C Certificate of Compliance
- ☐ Form MECH-1-C Mechanical Certificate of Compliance
- Form LTG-2-C Lighting Controls Credit Worksheet
- ☐ Form LTG-3-C Indoor Lighting Power Allowance
- ☐ Form MECH-2-C Air and Water System Requirements
- ☐ Form MECH-3-C Mechanical Ventilation and Reheat
- ☐ Form MECH-5-C Mechanical Equipment Details
- ☐ Form ENV-MM Envelope Mandatory Measures
- ☐ Form LTG-MM Lighting Mandatory Measures
- ☐ Form MECH-MM Mechanical Mandatory Measures, Parts 1 and 2
- ☐ Form LTG-4-C Tailored Method Worksheet
- Form OLTG-1-C Certificate of Compliance
- ☐ Form OLTG-2-C Lighting Compliance Summary
- ☐ Form SLTG-1-C Sign Lighting Compliance
- ☐ HVAC System Heating and Cooling Load Summary (optional)
- ☐ Zone Load Summary (optional)
- ☐ Room Load Summary (optional)
- ☐ Room Heating Peak Loads (optional)
- ☐ Room Cooling Peak Loads (optional)
- ☐ Room Cooling Coil Loads (optional)
- ☐ DOE-2 Simulation Output – Proposed (optional)
- ☐ DOE-2 Simulation Output – Standard (optional)
- ☐ Form UTIL-1 Utility Owner Incentive Worksheet (optional)
- ☐ Form UTIL-DT Utility Design Team Incentive Worksheet (optional)

☐Form ECON-1 Energy Use and Cost Summary (optional)

NOTE: All pages of the performance report are automatically stamped by the program with a Run Initiation Time, Runcode, and Date. The local enforcement agency may reject a compliance report if all these values are not the same on every page.

The program will also generate a preset selection of DOE-2.1E reports if **Delete Temporary Files After Simulation is Complete** is cleared (NOT checked) when performing NR T24 Performance calculations. These reports will be saved in the Results subfolder to a text file with the same name as your input file plus the extension of .SIM (i.e., *filename*.SIM).

You may customize which DOE-2 reports are included in the .sim file in the Utility Tab of the Building Element. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

See Also: Default DOE-2.1E Reports

Energy Conservation Measures Modeled by NR T24 Performance

The NR T24 Performance module models many building and system features. Given the nature of how the Standard Design is automatically generated by the program and used to set the annual TDV energy budget, it is important to keep track of and understand:

☐Which building measures and/or program inputs are modeled the same in the Standard Design and the Proposed Design; and

☐Which building measures and/or program inputs are modeled a certain way in the Standard Design, but may be modeled as an energy penalty, an energy credit, or as energy neutral in the Proposed Design.

Measures Modeled the Same in Standard and Proposed Designs

The following measures, or building/system attributes, are modeled the same way in the Standard Design to set the TDV energy budget as in the Proposed Design TDV energy use calculation.

Envelope and Lighting

☐Zoning of the building

☐Hourly schedules (including occupants, lights, equipment, fans, thermostats, infiltration, and service hot water)

☐Gross wall areas, by orientation and tilt, per zone

☐ Gross wall framing type: metal, wood, or other

☑ Glazing area in each exterior wall *except when the window-wall ratio (WWR) for the building is greater than 40% and no display perimeter is specified.*

☐ Interior window shade management

☐ Areas and types of doors, by zone

☐ Gross roof/ceiling areas, by orientation and tilt, per zone

☑ Glazing area in each roof/ceiling *except when the skylight-roof ratio (SRR) for the building is greater than 5%*

☐ Gross raised floor and slab-on-grade areas, per zone

☐ Opaque surface absorptivity*, excluding roofs.*

☐ Heat capacity of walls, roofs/ceilings and floors per zone

☐ Interior partitions between zones

☐ Demising partitions

☐ Unconditioned spaces

☐ Return air plenums

☐ Receptacle load

☐ Infiltration rate

☐ Ventilation rate (generally)

☐ Process loads, sensible

☐ Process loads, latent

☐ Modeled LPD when no lighting is designed: Value is set to the appropriate Complete Building lighting allotment, Table N2-5 if the Nonresidential ACM.

HVAC and Service Hot Water

☐ Proposed heating system capacity oversizing (heating system output divided by design heating load) up to 143%

☐ Proposed cooling system capacity oversizing (sensible cooling system output divided by design sensible cooling load) up to 121%

☐ Design fan power (i.e., fan size and fan motor efficiency) up to 0.8 watts/cfm for constant volume fans over 25 horsepower, and up to 1.25 watts/cfm for VAV fans over 25 horsepower

☐ Fan system operation

☐ Pump power (pump size and pump motor efficiency for boiler, chiller, and/or cooling tower

☐ Piping heat gains and heat loss

☐ All service hot water system attributes *except* recovery efficiency

Measures Modeled as a Penalty or Credit in Proposed Design

The following measures, or building/system attributes, are modeled in the Proposed building as designed. These features may be an energy credit, energy penalty, or be energy neutral as compared to the assumptions used in the Standard Design.

Envelope and Lighting

☐ Exterior wall insulation: *credit, neutral, or penalty*

☐ Placement of insulation in heavy mass wall assemblies: *credit or penalty*

☐ Exterior roof/ceiling insulation: *credit, neutral, or penalty*

☐ Placement of insulation in heavy mass roof assemblies: *credit or penalty*

☐ Raised floor insulation: *credit, neutral, or penalty*

☐ Placement of insulation in heavy mass raised floor assemblies: *credit, neutral, or penalty*

☐ Fenestration areas in walls greater than 40% window-wall ratio: *penalty*

☐ Fenestration areas in roofs greater than 5% skylight-roof ratio: *penalty*

☐ Fenestration U-Factors: *credit, neutral, or penalty*

☐ Fenestration solar heat gain coefficients: *credit, neutral, or penalty*

☐ Fenestration overhangs and sidefins: *credit (generally*)

☐ Installed or modeled lighting power density per Zone: *credit, neutral, or penalty*

☑ Lighting control credit per Zone: *credit*

HVAC and Service Hot Water

☐ Proposed heating system capacity oversizing (heating system output divided by design heating load) over 143%: *penalty*

☐ Proposed cooling system capacity oversizing (sensible cooling system output divided by design sensible cooling load) over 121%: *penalty*

☐ Heating equipment efficiency rating: *neutral or credit*

☐ Cooling equipment efficiency rating: *neutral or credit*

☐ System type: *credit, neutral, or penalty*

☐ Equipment part load performance: *credit, neutral, or penalty*

☐ Heat pump auxiliary (strip) heating sizing: *neutral or penalty*

☐ System supply air control: *credit, neutral, or penalty*

☐ Zone terminal controls: *credit, neutral, or penalty*

☐ Up to three different chillers staged with energy management system (EMS) controls: *credit, neutral, or penalty*

☐ Cooling tower sizing, approach temperature, fan speeds, pumps: *credit, neutral, or penalty*

☑ Design fan power (i.e., fan size and fan motor efficiency) greater than 0.8 watts/cfm for constant volume fans over 25 horsepower, and greater than 1.25 watts/cfm for VAV fans over 25 horsepower: *penalty*

☐ Pump control, flow rate, minimum operating ratio: *credit, neutral, or penalty*

☐ Fan system configuration: *credit, neutral, or penalty*

☐ Fan volume control (e.g., constant volume, forward curved centrifugal fan w/ discharge dampers, forward curved centrifugal fan w/inlet vanes, variable speed drive): *credit, neutral, or penalty*

☐ Air economizers: *credit, neutral, or penalty*

☐ Water side economizers: *credit, neutral, or penalty*

☐ Air-cooled, water-cooled, and evaporatively cooled condensers: *credit, neutral, or penalty*

☐ Evaporative cooling and evaporative pre-cooling: *credit, neutral, or penalty*

☐ Service hot water system recovery efficiency: *neutral or credit*

Which Forms Go On the Drawings?

According to Section 10-103 (a)(2) of the state's Administrative Regulations "the [permit] applicant shall file the appropriate Certificate(s) of Compliance on the plans." This means that the permit drawings must include a signed copy of the PERF-1, ENV-1, LTG-1 and MECH-1 forms, as appropriate for the scope of the project. Also include the appropriate Mandatory Measures forms.

Basis and Capabilities of NR T24 Performance

This section provides an overview of the NR T24 Performance calculations. NR T24 Performance is a proprietary California Title 24 energy compliance version of DOE-2.1E, a building energy analysis program developed by Lawrence Berkeley National Laboratory (LBNL) under contract to the U.S. Department of Energy. DOE-2 is widely regarded as a reference program for building energy simulations. The **Introduction to DOE-2** below is a somewhat modified and restructured version of explanations from the *DOE-2 User's Guide*, Volume 1, written by the Building Energy Analysis Group at LBNL. See the *DOE-2 User's Guide* for more detailed information on the algorithms used in DOE-2.

Introduction to DOE-2

DOE-2 is a public domain computer program which can be used to explore the energy behavior of proposed and existing buildings and their associated heating, ventilation and air conditioning (HVAC) systems. Incorporating mathematical models (called algorithms) and utilizing hourly weather data, DOE-2 calculates the hour-by-hour performance and response of a building whose description has been provided by the user.

DOE-2 calculates the estimated energy use of buildings in three primary steps:

1. **Loads Calculation.** First is the calculation of heat loss from and heat gain to the building zones, and the heating and cooling loads imposed upon the building HVAC systems. This calculation is carried out for a zone temperature fixed in time and is commonly called the Loads calculation. It answers the question: How much heat addition or extraction is required to maintain the zone at a constant temperature as the outside weather conditions and internal activity vary in time and the building mass absorbs and releases heat?

   DOE-2's Loads module calculates the heating and cooling loads of a building, assuming a fixed indoor temperature. The calculations are based for the most part on standard ASHRAE algorithms and techniques. The load is divided into components which are calculated hourly. The components are divided into two classes, external and internal. The external components are the loads caused by heat conduction through walls and windows, infiltration through windows and walls, and solar gain through windows. The internal components are the loads caused by people, lights and equipment inside the building.

2. **Systems Calculation.** Second is the calculation of the energy addition and extraction actually to be supplied by the HVAC system to meet the possibly varying temperature set-points and humidity criteria subject to the schedules of fans, boilers and chillers, and to outside air requirements. This calculation results in the demand for energy that is made on the primary energy sources of the building. This step, called the Systems calculation, answers the question: How are the accumulative heat extraction and addition rates modified, when the characteristics of the HVAC system, the time-varying set-points, and the heating, cooling and fan schedules are taken into account?

The Systems simulation gives primary importance to the individual operating characteristics of the numerous air and water distribution systems. This improves the accuracy of the calculations, but requires program users to have a detailed understanding of how HVAC systems work.

Another feature of the Systems calculations is the treatment of floating point temperatures. In Loads, the zone temperatures are assumed to be constant, and the thermal loads are calculated at a single set-point. In Systems, the set-point temperatures may be reset for day-night and summer-winter conditions. The floating temperature routine calculates the thermal response of the building when no mechanical heating or cooling is occurring. It simulates the decay in zone temperatures when the systems are turned off and the lag in recovery of zone temperatures when the systems are turned back on. Finally, this routine takes into account the throttling range of the thermostat and the limitation of equipment heating and cooling capacities. All of these interactions are significant to the energy transferred at coil surfaces, and this is the energy that is relevant to the primary energy sources, the concern of the Plant simulation.

3. **Plant Calculation.** Third is the determination of the fuel requirements of primary equipment such as boilers and chillers, and of the energy production of solar collectors, etc., in the attempt to supply the energy demand of the HVAC systems. This Plant calculation answers the question: How much fuel and electrical input is required to feed the secondary HVAC system given the efficiency and operating characteristics of the plant equipment and components?

   The Plant program converts the energy supplied to space heating and cooling equipment into the energy actually consumed by boilers, chillers, pumps, engines, etc. It sums the hourly demand of the electricity used by lights, fans, and equipment, and of the fuel used by boilers and engines. It also accounts for any heat recovered. From these totals it generates monthly and yearly energy usage reports.

4. **Economics Calculation.** DOE-2 also includes an Economics calculation which estimates the cost of energy used in a building.

Building Features Modeled by NR T24 Performance

NR T24 Performance handles a wide range of common building energy conditions and conservation strategies. These include:

Envelope Parameters

Thermal Mass

Solar Heat Gain

Internal Gains

HVAC Equipment

Envelope Parameters

These include U-Factors for all conduction surfaces of the building: roofs, walls, floors, windows, skylights, and doors. Outside air is also included, either through infiltration or ventilation. DOE-2 calculates the effects of these parameters using standard ASHRAE methodology, based on the areas and assemblies for each type of surface, and the values input for infiltration and ventilation rates. In the software, conduction surfaces are input in the Room element, with opaque assemblies defined in the Assembly Library and glazing types defined in the Fenestration Library. Infiltration and Ventilation Schedules are input in the Zone element, but are fixed by the CEC for Title 24 compliance calculations. Rates of Infiltration (AC/H) and Ventilation (cfm/occupant) are input in the Room element.

Thermal Mass

Thermal mass in the building walls acts like a flywheel to moderate the temperature flows between the building and the environment. DOE-2 calculates the thermal mass effects for each building based on the characteristics of the assemblies selected for roofs, walls, floors, and windows in each Room element, with opaque assemblies defined in the Assembly Library, and glazing types defined in the Fenestration Library.

Solar Heat Gain

Solar heat gains enter the building by two routes: through the glazing, which may have shading devices, and through the opaque surfaces. Solar gain depends on the solar heat gain coefficient of the glazing, the interior and exterior shades, and the absorptivity of the opaque surfaces. Solar heat gain coefficients of glazing are defined in the Fenestration Library. Overhangs and Sidefins are defined in the Overhang and/or Sidefin Libraries. The absorptivity of opaque surfaces is fixed by the CEC for compliance and calculated automatically (although it may be adjusted in the Assembly Library for heating and cooling loads calculations).

Internal Gains

Internal gains include all indoor heat-generating components: lighting, occupants, receptacle electric usage, and supply fans. The values of these components for each hour are used to determine the internal gain energy. Gains for occupants and receptacles are fixed values set by the CEC for each building type and are calculated by the software automatically.

HVAC Equipment

All building characteristics for the zone(s) served are properly aggregated and assigned to the HVAC system element above the particular zone(s). Schedules for HVAC equipment are set in the Zone element. Specific data for each system is found in the CEC equipment directories and manufacturer's literature. See **Libraries** for further information on each of these libraries and the inputs required for each system type.

HVAC System Types

Many nonresidential HVAC system types may be modeled using NR T24 Performance. These include:

- ☐ Split DX Systems
- ☐ Packaged DX Systems
- ☐ Hydronic Heat Pump
- ☐ Packaged Variable Air Volume
- ☐ Packaged Multi-Zone
- ☐ Built-Up Single Zone
- ☐ Built-Up Variable Air Volume
- ☐ Built-Up Multi-Zone
- ☐ Dual Duct
- ☐ Four-Pipe Fan Coil
- ☐ Room Packaged Terminal Air Conditioner
- ☐ Packaged Variable Air Volume and Variable Temperature (VVT)
- ☐ Four Pipe Induction
- ☐ Evaporative Cooler

See Also:

Central System Library

Zonal Library

Special Topics, Mechanical Systems

Special Topics, Nonresidential Compliance Modeling Topics

ASHRAE 90.1 Performance Module

See Also: ASHRAE 90.1 Performance Calculation Options, ASHRAE 90.1 Performance Calculation Results, and ASHRAE 90.1 Performance Reports

EnergyPro's ASHRAE 90.1 Performance module for nonresidential projects allows you to document project performance with ASHRAE 90.1: 2004 and 2007 versions. EnergyPro uses the Performance Rating Method, as defined in Appendix G of the standard to model the building energy performance.

While the 2007 version is the most recent version of the standard, the 2004 version is considered the commercial building reference standard for state building energy codes under the federal Energy Policy Act of 2005. The Act also requires all federal facilities to exceed ASHRAE 90.1-2004 by 30%, provided it is cost-effective to do so. In addition, USGBC's LEED rating system, references the 2004 version of the standard.

To select which version of the standard EnergyPro will use to create the baseline energy (and energy cost) data, select Options… from the Tools menu. Select the appropriate version of the ASHRAE 90.1 standard and Title 24 standard from the drop-down list on the Miscellaneous Tab.

ASHRAE 90.1 Performance Rating Method (Appendix G):

EnergyPro's ASHRAE 90.1 Performance module uses the Performance Rating Method specified in Appendix G of the standard, to create an hourly simulation to generate the baseline and proposed energy use and cost data. EnergyPro automatically creates the baseline data required by the standard as well as the proposed design data.

To calculate the baseline data, Appendix G requires the building to first be modeled at its actual orientation, then it must be rotated by 90, 180, and 270 degrees. The baseline against which the proposed design is compared is the average of the four runs, calculated automatically by the program. EnergyPro displays the end-use energy usage results for each orientation, automatically calculates the average, and displays both the baseline and the proposed energy cost estimates and the margin between the baseline and proposed design.

Refer to the ASHRAE web site to obtain additional details and/or copies of the ASHRAE 90.1-2004 of 2007 Standards.

ASHRAE Policy Statement

ASHRAE 90.1 Performance Results

See Also: ASHRAE 90.1 Performance Calculation Module, ASHRAE 90.1 Performance Calculation Options, and ASHRAE 90.1 Performance Reports

When the calculation is complete, the display summarizes the results of the NR 90.1 Performance calculation according to category of energy end use. The NR 90.1 Performance **Baseline** Annual Site Energy Use Estimate (in kBtu/sqft-yr) is shown for each orientation, and the **Proposed** Building Total energy use.

All calculation results displayed are for the building as a whole in kBtu/sqft-yr. Categories of energy end use are as follows:

Heating: Annual energy used for space heating

Cooling: Annual energy used for space cooling

Lighting: Annual energy used for electric lights

Process Lighting: Annual energy used in process lighting input within the program

Outdoor: Annual energy used for outdoor lighting

Receptacle: Annual energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.

Renewables: Annual energy provided by renewable systems. This value is negative and is subtracted from the total proposed energy use.

Fans: Annual energy used for fans moving conditioned air

Heat Rejection: Annual energy used for cooling tower operation

Pumps: Annual energy used pumps for hot water, chilled water, and condenser water piping systems

Process: Annual energy used in process loads input within the program

DHW: Annual energy used for domestic (service) hot water

Total: The Total annual energy used by the building.

Baseline Energy Cost: The estimated annual energy cost for the baseline building design. EnergyPro automatically calculates the average cost (across the four orientations).

Proposed Energy Cost: The estimated annual energy cost of the proposed building design.

Percent Better: The difference (percentage) between the proposed and baseline design energy costs. If this number is negative, the estimated proposed design energy costs are higher than the baseline design.

LEED EAc1 Points: The number of LEED Energy and Atmosphere points the proposed design is eligible to earn through optimizing energy performance (LEED Energy and Atmosphere, Credit 1). LEED requires each new construction project submitted for certification after 6-26-2007 to earn at least two points in this category. Thus, the proposed design must exceed ASHRAE 90.1-2004 baseline by at least 14%.

Process: The percentage of the energy cost attributed to process loads. LEED default assumption is 25%. If the process energy cost for the proposed design is less than 25%, you must submit documentation substantiating the values.

NOTE: You should have a copy of the appropriate ASHRAE 90.1 Standard available for reference when using the NR 90.1 Performance module.

ASHRAE 90.1 and T24 LEED Performance Calculation Options

See Also: ASHRAE 90.1 Performance Calculation Module, ASHRAE 90.1 Performance Results, and ASHRAE 90.1 Performance Reports

Calculations

Run Baseline(s):

ASHRAE 90.1: Runs the four Baseline simulations which sets the energy cost budget for the building. Appendix G of ASHRAE 90.1 uses the average results from the four simulations (actual, +90, +180, and +270 degrees) to set the budget.

T24 LEED: Runs the 2005 Title 24 baseline as described above, though it can also use a 2008 Title 24 baseline for the simulation. You must instruct EnergyPro to use the appropriate Reference Standard.

Run Proposed: Runs the Proposed Design whose energy use is compared with the energy cost budget.

Scope: Sets the project Scope. Check Envelope, Indoor Lighting, Outdoor Lighting, Mechanical and/or Domestic Hot Water to set the scope of the analysis. Include all project components for which a permit is desired or that are part of the project scope.

Delete Temporary Files After Simulation is Complete: Deletes the DOE-2.1E files once the simulation is complete. Only the final results are saved in the software file. Do not check this box if you wish to keep a copy of the DOE-2 input (BDL) or output (SIM) files, or if you need to troubleshoot a file that doesn't run properly.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

DOE-2 Reports: You may select specific DOE-2 output reports in the Utility Tab of the Building Element. If you do not make any selection, the DOE-2 output will contain only the default DOE-2 reports.

WARNING: In order to have any DOE-2 reports available, you must instruct the software to save the DOE files after the run. Remove the check mark from the Delete DOE Files After Run checkbox (see above).

The ASHRAE 90.1 Performance calculation uses the U. S. Department of Energy's DOE-2.1E (version 119) program, which is a comprehensive hourly building energy simulation program.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

NOTE: If you need to review the intermediate NR ASHRAE 90.1 Performance files to identify a program error, look at the .BDL file first; then look at the .SIM file. This can be done with a word processor.

ASHRAE 90.1 and LEED T24 Performance Reports

EnergyPro creates reports documenting the project's energy features, estimated energy usage, and energy costs. See Printing Reports for basic instructions. Select Reports from the options in the lower-left window pane to select the appropriate pages for a report.

EnergyPro ASHRAE 90.1 Performance reports include the following forms:

- Cover Sheet
- Table of Contents
- Form EAC-1 - LEED Compliance Summary
- Form MECH-5 – Mechanical Equipment Details
- Form ECON-1 – Energy Use and Cost Summary
- HVAC System Heating and Cooling Load Summary
- Zone Load Summary
- Room Load Summary
- Room Heating Peak Loads
- Room Cooling Peak Loads
- Room Cooling Coil Loads

- DOE-2 Simulation Output – Proposed
- DOE-2 Simulation Output – Standard

NOTE: All pages of the performance report are automatically stamped by the program with a Run Initiation Time, Run Code, and Date. The local enforcement agency may reject a compliance report if all these values are not the same on every page.

The program will also generate a preset selection of DOE-2.1E reports if **Delete Temporary Files After Simulation is Complete** is cleared (NOT checked) when performing ASHRAE 90.1 Performance calculations. These reports will be saved in the Results subfolder to a text file with the same name as your input file plus the extension of .SIM (i.e., *filename*.SIM).

You may customize which DOE-2 reports are included in the .sim file in the Utility Tab of the Building Element. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

See Also: Default DOE-2.1E Reports

Title 24 LEED Performance Module

See Also: ASHRAE 90.1 and T24 LEED Performance Calculation Options, T24 LEED Performance Calculation Results, and ASHRAE 90.1 and T24 LEED Performance Reports

EnergyPro's new LEED Title 24 Performance module allows you to document compliance with the LEED energy-related requirements using the California Title 24 option. LEED (Leadership in Energy and Environmental Design), is a green building rating system developed by the US Green Building Council.

LEED 2009 calculations require all projects to meet minimum requirements in five categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. In the Energy and Atmosphere category, projects must meet prerequisite energy performance specifications. In addition, projects may earn points for optimizing the energy performance or using renewable energy systems to generate some of the energy onsite.

LEED Energy and Atmosphere Prerequisite 2: Minimum Energy Performance

Option 1, the Whole Building Energy Simulation requires that the proposed new construction project exceed the baseline performance by 10% (based on energy costs). Existing building remodels must exceed the baseline by 5%. For projects in CA, you may choose either Appendix G of ASHRAE 90.1-2007 or 2005 Title 24, Part 6 as the baseline against which the proposed project is compared. EnergyPro's LEED T24 Performance module will perform either calculation.

Note that you must instruct EnergyPro to use the appropriate Reference Standard in the simulation. The selected reference standard is displayed in the status bar in the lower-right corner of the window and will appear on Form EAC-1, LEED Compliance Summary.

LEED Energy and Atmosphere, EA Credit 1: Optimize Energy Performance

The project may earn points for exceeding the selected baseline by 12% or more for new construction, or by 8% or more for existing building renovations.

T24 LEED Performance Results

See Also: ASHRAE 90.1 Performance Calculation Module, ASHRAE 90.1 Performance Calculation Options, and ASHRAE 90.1 Performance Reports

When the calculation is complete, the display summarizes the results of the NR 90.1 Performance calculation according to category of energy end use. The NR 90.1 Performance **Baseline** Annual Site Energy Use Estimate (in kBtu/sqft-yr) is shown for each orientation, and the **Proposed** Building Total energy use.

All calculation results displayed are for the building as a whole in kBtu/sqft-yr. Categories of energy end use are as follows:

Heating: Annual energy used for space heating

Cooling: Annual energy used for space cooling

Lighting: Annual energy used for electric lights

Process Lighting: Annual energy used in process lighting input within the program

Outdoor: Annual energy used for outdoor lighting

Receptacle: Annual energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.

Renewables: Annual energy provided by renewable systems. This value is negative and is subtracted from the total proposed energy use.

Exceptional: Annual Energy saved from reducing process loads. To take credit for reducing process loads in the proposed project, LEED requires that you use the Exceptional Calculation Method in Appendix G, (G2.5) to document the measure. Enter the energy savings resulting from the Exceptional Method in the Plant Element of the Building Tree.

Fans: Annual energy used for fans moving conditioned air

Heat Rejection: Annual energy used for cooling tower operation

Pumps: Annual energy used pumps for hot water, chilled water, and condenser water piping systems

Process: Annual energy used in process loads input within the program

DHW: Annual energy used for domestic (service) hot water

Total: The Total annual energy used by the building.

Baseline Energy Cost: The estimated annual energy cost for the baseline building design.

Proposed Energy Cost: The estimated annual energy cost of the proposed building design.

Percent Better: The difference (percentage) between the proposed and baseline design energy costs. If this number is negative, the estimated proposed design energy costs are higher than the baseline design.

LEED EAc1 Points: The number of LEED Energy and Atmosphere points the proposed design is eligible to earn through optimizing energy performance (LEED Energy and Atmosphere, Credit 1). LEED requires each new construction project submitted for certification after 6-26-2007 to earn at least two points in this category. Thus, the proposed design must exceed ASHRAE 90.1-2004 baseline by at least 14%.

Process: The percentage of the energy cost attributed to process loads. LEED default assumption is 25%. If the process energy cost for the proposed design is less than 25%, you must submit documentation substantiating the values.

NOTE: You should have a copy of the appropriate ASHRAE 90.1 or Title 24 Standard available for reference when using the NR T24 LEED Performance module.

NR Performance Calculation Module

See Also: NR Performance Calculation Options, NR Performance Results, and NR Performance Reports

Use the NR Performance Module to simulate the energy performance of a project that doesn't involve a particular Standard. EnergyPro allows you to compare the proposed design energy use to the energy use of a building that just meets the Title 24 Standard if you choose. NR Performance performs an hourly simulation on the building to determine annual energy consumption and energy cost. In addition, this module can be used for the Savings By Design utility incentive program as a supplement to the Nonresidential Title 24 Performance module as it will allow for calculation of the "Non-compliance" standard and proposed building energy use which can be used for incentive purposes (under certain circumstances, check with the utility regarding eligibility).

NR Performance Options

See Also: NR Performance Module, NR Performance Results, and NR Performance Reports

Calculations

Run T24 Standard: Runs the Title 24 Standard Design, but produces energy use results (in kBtu/sqft) rather than using Title 24's TDV energy structure.

Run Proposed: Runs the Proposed Design, without using code default values.

Scope: Sets the project Scope. Check Envelope, Lighting, Mechanical and/or Domestic Hot Water to set the scope of the analysis.

Delete Temporary Files After Simulation is Complete: Deletes the DOE-2.1E files once the simulation is complete. Only the final results are saved in the software file. Do not check this box if you wish to keep a copy of the DOE-2 input (BDL) or output (SIM) files, or if you need to troubleshoot a file that doesn't run properly.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

Reports: You may select specific DOE-2 output reports in the Utility Tab of the Building Element. If you do not make any selection, the DOE-2 output will contain only the default DOE-2 reports.

WARNING: In order to have any DOE-2 reports available, you must instruct the software to save the DOE files after the run. Remove the check mark from the Delete DOE Files After Run checkbox (see above).

The NR Performance calculation uses the U. S. Department of Energy's DOE-2.1E calculation engine (v119), which is a comprehensive hourly building energy simulation program.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

NOTE: If you need to review the intermediate NR Performance files to identify a program error, look at the .BDL file first; then look at the .SIM file. This can be done with a word processor.

NR Performance Results

See Also: NR Performance Module, NR Performance Calculation Options, and NR Performance Reports

When the calculation is complete, the display summarizes the results of the NR Performance calculation according to category of energy end use. The NR Performance Standard (if selected) Annual Site Energy Use Estimate (in kBtu/sqft-yr) is shown for each orientation, and the Proposed Building Total energy use.

All calculation results displayed are for the building as a whole in kBtu/sqft-yr. Categories of energy end use are as follows:

Heating: Annual energy used for space heating

Cooling: Annual energy used for space cooling

Lighting: Annual energy used for electric lights

Process Lighting: Annual energy used in process lighting input within the program

Outdoor: Annual energy used for outdoor lighting

Receptacle: Annual energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.

Renewables: Annual energy provided by renewable systems. This value is negative and is subtracted from the total proposed energy use.

Exceptional: Annual Energy saved from reducing process loads. This value is only used for LEED projects.

Fans: Annual energy used for fans moving conditioned air

Heat Rejection: Annual energy used for cooling tower operation

Pumps: Annual energy used pumps for hot water, chilled water, and condenser water piping systems

Process: Annual energy used in process loads input within the program

DHW: Annual energy used for domestic (service) hot water

Total: The Total annual energy used by the building.

NR Performance Reports

See Also: NR Performance Module, NR Performance Calculation Options, and NR Performance Results

EnergyPro creates reports documenting the project's energy features, estimated energy usage, and energy costs. See Printing Reports for basic instructions. Select Reports from the options in the lower-left window pane to select the appropriate pages for a report.

EnergyPro NR Performance reports include the following forms:

- Cover Sheet
- Table of Contents

- Form MECH-5 – Mechanical Equipment Details
- Form ECON-1 – Energy Use and Cost Summary
- HVAC System Heating and Cooling Load Summary
- Zone Load Summary
- Room Load Summary
- Room Heating Peak Loads
- Room Cooling Peak Loads
- Room Cooling Coil Loads
- DOE-2 Simulation Output – Proposed
- DOE-2 Simulation Output – Standard

NOTE: All pages of the performance report are automatically stamped by the program with a Run Initiation Time, Run Code, and Date. The local enforcement agency may reject a compliance report if all these values are not the same on every page.

The program will also generate a preset selection of DOE-2.1E reports if **Delete Temporary Files After Simulation is Complete** is cleared (NOT checked) when performing ASHRAE 90.1 Performance calculations. These reports will be saved in the Results subfolder to a text file with the same name as your input file plus the extension of .SIM (i.e., *filename*.SIM).

You may customize which DOE-2 reports are included in the .sim file in the Utility Tab of the Building Element. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

See Also: Default DOE-2.1E Reports

NR Loads Calculation

Section 144(b) of the *Standards* states that for load calculations done in conjunction with compliance (with the *Standards)*, indoor design conditions shall be in accordance with ANSI/ASHRAE 55-1981, except that humidification and dehumidification need not be considered. Heating and cooling design loads shall be determined in accordance with the procedures described in the ASHRAE Handbook, *1989 Fundamentals Volume*, the ASHRAE *Cooling and Heating Load Calculation Manual*, or an equivalent computation procedure approved by the Executive Director of the CEC. Outdoor design air temperatures shall be no lower than the temperature listed in the Winter Median of Extremes column for heating and no greater than the 0.5% Summer Dry Bulb and 0.5% Wet Bulb columns for cooling, based on percent-of-year in ASHRAE publication #96500*: Climatic Data for Region X, Arizona, California, Hawaii and Nevada, 1982*.

The NR Loads calculation is based on the ASHRAE *Cooling and Heating Load Calculation Manual* as applied to each Mechanical System specified within the program. The program performs an hourly simulation to determine cooling loads using explicitly calculated solar gain factors for the month and explicitly calculated weighting and response factors for thermal mass effects. The Schedules selected control the lights,

equipment, infiltration, occupants, ventilation and thermostats each hour of the design day. The summer dry bulb and wet bulb design temperatures affect the sensible output capacity of the Mechanical System according to a standard equipment performance curve used by the NR Performance program.

The program calculates cooling loads for all months and displays the peak loads on screen. The peak month and hour are shown on the Room Cooling Loads Summary form in the final report. Use Print Preview to view the data prior to printing.

NOTE: Cooling design temperatures for January through June and September through December are automatically modified by the program (reduced somewhat) in relation to the values listed in the Location Library to reflect a lower probability of reaching the listed design temperature in months other than July and August.

NR Loads Calculation Options

Winter Design Conditions: Select the winter design conditions to use for the load calculations from the drop-down list. Choices include: Median of Extremes, 2.0% Design Data, and 6.0% Design Data. Median of Extremes is the default value. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982*.

Summer Design Conditions: Select the summer design conditions to use for the load calculations from the drop-down list. Choices include: 0.5%/0.4% Design Data, 1.0% Design Data, and 2.0% Design Data. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982.*

Use Design Wet Bulb (not Mean Coincident): Check the checkbox to use the Design Wet Bulb rather than the Mean Coincident value in the load calculations.

Ignore Exterior Shades in Load Calculations: check the checkbox if you wish to calculate loads without the effects of any exterior shades.

Design Day for Schedules: Select a day of the week to use as the Design Day for Schedules, or select Ignore to set all to 100%. The program will use the weekly schedules you have selected throughout the building description, using the day of the week you have selected. When the variable is set to Ignore Schedules (use 100%), the program automatically overrides the schedules selected and runs maximum (100% on, 24 hours per day) schedules in all load calculations.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 5\Results folder under the project name with a .csv extension.

The **NR Loads** calculation is the full hourly nonresidential ASHRAE heating and cooling loads method.

NR Loads Results

Components of the NR Loads Calculation Results

System: The name of the Mechanical System serving the Zone(s) selected.

Heat Load: The design block heating load of all the Zones served by the System, in Btu/hr.

Heat Output: The heat output of the mechanical system, in Btu/hr.

Sensible Load: The design block sensible cooling load of all the Zones served by the System, in Btu/hr.

(tons): The design block sensible cooling load of all the Zones served by the System, in tons.

Sensible Output: The cooling output of the mechanical system, in Btu/hr.

(tons): The cooling output of the mechanical system, in tons.

Latent Load: The design block latent cooling load of all the Zones served by the System, in Btu/hr.

Latent Output: The design block latent cooling output of all the Zones served by the System, in Btu/hr.

Using NR Performance as a DOE-2 BDL and Report Generator

The software's Win/DOE module is designed to use the DOE-2.1E energy analysis program to demonstrate compliance with the California energy standards. It may also be used for noncompliance energy analyses. Users familiar with DOE-2 may also use the software to generate standard DOE-2 input files (BDL) which include most of the required building data, and generate a DOE-2 output report that can be printed or edited outside of the program. The BDL (Building Description Language) input files can be edited using a word processor to add features or reports not applicable to Title 24 compliance. Once the BDL input file has been edited, it can be run outside of the software shell using the version of DOE-2.1E which comes with the Win/DOE compliance module.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

To use Win/DOE as a DOE-2.1E input file generator, and to run calculations on a DOE-2 input file outside of the software's interface, follow these steps:

1. Use the software to input and save all building information, including correct zoning, HVAC systems, operating schedules, and construction assemblies. See item 4 below if you prefer to use DOE-2's default material library.
2. Select the **Win/DOE** tab from CalcManager/Options.

To create an input file without running Win/DOE calculations, check **Generate DOE Input File Only (Do NOT Run Simulation).** Check **Run Proposed** under Compliance Calculations if you want an input file that combines your building information with the CEC default values. Check **Run Proposed** under Noncompliance Calculations for a file that uses only your input values, without the CEC defaults. Check **Domestic Hot Water** under Scope to include a full DOE-2 input file on the water heating system defined in the software. Under **Scope**, also check the applicable categories (Envelope, Lighting, Mechanical).

If either Run Standard Compliance or Run Standard Noncompliance are checked, the program will create the DOE-2 input files used to generate the compliance or noncompliance energy budgets (the Standard Design energy use).

When you run the selected calculations, the new BDL input file is saved in the WinDOE folder. The file has whatever name you gave it when you saved it, plus the extension .DOE. This extension must be present to analyze any input file with Win/DOE. For example, the nonresidential sample building file is named *NonRes Sample.bld* within the software. A BDL input file for it would be named *NonRes Sample.DOE*.

1. Edit the file with any word processor in non-document mode. To do this you must be familiar with the standard DOE-2 commands and input structure.
2. To run DOE-2 on the revised file, from the WinDOE folder, type:

   DOE21e *inputfile weatherfile* and press <Enter>.

inputfile is the BDL input file name with the extension .DOE (e.g., *NonRes Sample.DOE*)

NOTE: If the input filename contains a space in the name (e.g., NonRes Sample.DOE), you must enclose the name in quotes. See below for sample.

weatherfile is the path and file name of the weather data file for your project (e.g., *C:\EP3\WEATHER\CZ12RV2.WY2*).

For example, to run the file *NonRes Sample.DOE* with the weather file named *CZ12RV2.WY2* (Climate Zone 12) type:

DOE21e "NONRES SAMPLE.DOE" C:\EP3\WEATHER\CZ12RV2.WY2 and press <Enter>.

If you want to edit the BDL input file to use DOE-2's default material library instead of the material library included with **EnergyPro**, then you need to change the library reference files before running calculations. First, go to the WinDOE folder and rename the **EnergyPro** material library file, *BDLLIB.BIN*, to save it for later projects using Windows Explorer. Next, copy the file named *DOE2.BIN*, the file with the DOE-2 libraries, to BDLLIB.BIN. Now you are ready to run DOE-2 calculations as described above. To use the **EnergyPro** material library in a later project, copy that file back to *BDLLIB.BIN*.

1. When all calculations are complete, the output files are located in the Win/DOE folder. Files with the extension .BDL (e.g., *NonRes Sample.BDL*) are processed versions of the BDL input file, including any error messages or warnings. Files with the extension .OUT (e.g., *NonRes Sample.OUT*) include all final DOE-2 calculations and reports for further review or analysis. See Default DOE-2.1E Reports in the NR Output .SIM File for a list of the default DOE-2 reports generated in each .SIM file.

Default DOE-2.1E Reports in the NR Output (.SIM) Files

Whenever the software performs NR simulations using DOE-2, it creates input and output files. For Title 24 compliance, the program automatically retrieves the required data from the DOE-2 output reports, and displays the results on-screen. As DOE-2 files can be quite large, the software saves only the results and deletes the DOE-2 files unless you specify otherwise.

If you would like to save the DOE-2 files, you must instruct EnergyPro to save them. Select Calculations from the list in the lower left window pane, and for each simulation type, clear, (uncheck) the **Delete Temporary Files After Simulation is Complete** check box. Specify all other calculation options as usual. The DOE-2 files are saved in your Results folder (specified in the Tools/Options… menu).

You may customize which DOE-2 reports are included in the .sim file in the Utility Tab of the Building Element. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file. If you do not select specific DOE-2 reports, the output file will contain only the default reports listed below.

Three reports will always be included in the output file regardless of your selections: BEPS, ES-D, and ES-F. These reports are not shown as selections in the DOE-2 Report Choices dialog box.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

The .SIM file includes the following default DOE-2 reports:

Loads Reports:

LS-D: Building Monthly Loads Summary

Systems Reports:

SV-A System Design Parameters

SS-P: Load, Energy and Part Load Heating and Cooling for System and/or Plant-Assignment

SS-A: System Monthly Loads Summary

SS-Q: Heat Pump Cooling and Heating Summary

Plant Reports:

PV-A: Equipment Sizes

PS-B: Monthly Utility and Fuel Use Summary

PS-D Plant Loads Satisfied

BEPS: Building Energy Performance Summary

Economic Reports:

ES-D: Energy Cost Summary

ES-E: Summary of Utility Rate

ES-F: Block Charge and Ratchet Summary

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Using NR Performance for Noncompliance Energy Analysis

In addition to its use as a Title 24, ASHRAE 90.1, and LEED nonresidential compliance calculations, NR Performance can also be used to:

- ☐ determine the annual energy use of a proposed building *without using fixed Title 24, ASHRAE 90.1, or LEED inputs* such as occupancy schedules and equipment type;
- ☐ determine the monthly and annual electricity usage and demand charges for a proposed building using any utility rate structure.

The NR Performance noncompliance mode allows you to modify certain inputs normally fixed or restricted for the code compliance calculation. You may run NR Performance with user-defined schedules and occupant densities, as well as any rate structure from the Utility Rate Library. In the NR T24 Performance Calculations Options, check **Run Standard**, and **Run Proposed**. Select the appropriate **Scope** categories, and clear (un-check) **Delete DOE Files After Run,** if you wish to save the DOE-2 output files.

To run DOE-2.1E as a stand-alone program from the BDL input file generated by **EnergyPro**, see Using NR Performance as a DOE-2 BDL and Report Generator.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

Detailed Calculation Data

You may save detailed calculation data from any residential or nonresidential calculation module that runs an hourly simulation. First, select Calculations from the options in the left window pane, then place a check in the

checkbox for each calculation you wish to run. Each module has calculation options that allow you to customize the specific calculation features and the data you wish to save for additional analysis.

The default setting for all modules is to Delete Temporary Files when the simulation is complete. Clear the checkbox to save the files. You must clear the Delete Temporary Files box to enable the option to Generate CSV Output File, which contains the detailed hourly output files in the comma-separated values (.csv) format.

Note: The Delete Temporary Files option will overwrite the Generate CSV Output Files option. If you select the Generate CSV Output File option, then re-select the Delete Temporary Files checkbox, the program will delete the files, and will NOT generate a csv file.

Residential Performance Modules generate project input files (.inp) for all selected simulations, including alternative runs. Nonresidential Performance Modules generate three DOE-2 files: two input files (.bdl and .doe), and the simulation results (.sim). All temporary files can be read using text editor or word processing software such as Notepad™ or Wordpad™.

CSV files include detailed hourly temperature and energy use data for each fuel type and end use in the simulation. Use Excel™ or another spreadsheet program to open the files.

Alternatives Tab (All Residential Modules)

Use the Alternatives Tab to select energy-savings measures to simulate the effect on a residential project's energy use, compliance, HERS Index or GreenPoint Rated score. EnergyPro will run the primary calculation, followed by each alternative you select and will display the results in tabbed format in the lower-right window pane. You may click on any tab to display the results for that module.

Some of the Alternative Measures DO NOT apply to all calculations. For example, Indoor Lighting is a mandatory measure in Title 24, thus alternatives will not change the project's compliance results.

Note that if you run multiple calculations at one time, EnergyPro will automatically run the same Alternatives for each calculation (provided you check the box(es) on the Options Tab for that calculation). You may not run different alternatives for each module in the same calculation event.

For each alternative measure you wish to simulate, check the checkbox and enter the alternative energy feature. You must also select either Run Individual or Run Combined Alternative Measures in the appropriate Options Tab.

Note that the Measure Cost fields are used only to generate cost-effective measure recommendations for a HERS report. You may click either the Select Button to select the measure cost from the HERS database, or check the User Defined checkbox and enter a custom measure cost. You must export the project data, and submit the resulting XML file to a HERS Provider for processing to print the HERS Report and view the alternative measure recommendations.

If you mark a building feature or equipment as "New", EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

Alternative Measures

Roof Insulation: Select the alternative Roof assembly from the Assembly Library

Wall Insulation: Select the alternative Wall assembly from the Assembly Library.

Floor Insulation: Select the alternative Floor assembly from the Assembly Library.

Windows: Select the alternative windows from the Fenestration Library.

HVAC System: Select the alternative HVAC System from the Central System Library.

HVAC Duct Leakage: Select the alternative leakage level from the drop-down list. Choices include: Leaky (22-28%), Moderate (15%), Tight (8%), Very Tight (6%), and Sealed in Conditioned (0%).

HVAC Duct Insulation: Enter the alternative Duct Insulation R-Value.

Building Leakage: Select the alternative Building Leakage level from the drop-down list. Choices include: No Testing, Specific Leakage Area, and Airflow.

Appliances: Enter the alternative Appliance characteristics for the inside or outside refrigerator, or dishwasher (displayed as DW). Enter the annual energy usage for the alternative refrigerator using the published EnergyGuide label information, if known. The default values are 775 kWh/yr for the inside refrigerator, 1,013 kWh/yr for each additional refrigerator, and 929 kWh/yr for each standalone freezer.

Enter the alternative Energy Factor for the dishwasher, using the published value, if available. The default value is 0.46.

Indoor Lighting: Select the alternative Fixture Type and Control for ALL indoor lights. Choices include: High Efficacy, Screw-in CFL, or Incandescent fixture types, and On/Off Switch, Dimmer, or Occupant Sensor controls. You may not select only a portion of the indoor lighting for this alternative calculation.

Outdoor Lighting: Select the alternative Fixture Type and Control for ALL outdoor lights. Choices include: High Efficacy, Screw-in CFL, or Incandescent fixture types, and On/Off Switch, Dimmer, or Occupant Sensor controls. You may not select only a portion of the indoor lighting for this alternative calculation.

Domestic Hot Water Heater: Select the alternative Domestic Hot Water heater from the Boiler Library.

Solar Domestic Hot Water: Enter the alternative Net Solar Fraction (portion of the annual water heating energy provided by a solar system). You may use this alternative to either specify the addition of solar water heating (from 0% Net Solar to some specified percentage, or to simulate a change to an existing system that increases the percentage of energy provided by solar).

Renewables: Enter the alternative energy cost savings ($) and energy production from a renewable source, in kWh/yr and TDV energy.

Calibration Tab (All Modules)

The Calibration feature allows you to compare the results of the simulation to the actual energy usage and costs for a project. Select Calculations from the list in the lower-left window pane, select the appropriate calculation module, then select the Calibration Tab.

You must enter the Utility Rate information in the Schedule Library prior to the calculation to generate a utility cost estimate. Then, in the Calibration Tab, enter the monthly usage and cost data using the Electricity and Gas tabs, and select the Billing Data Start Date from the drop-down calendar. You may now compare the simulated results to the actual usage and cost data to identify any major discrepancies and to calibrate your building model.

Nonresidential Sample Building

This section illustrates how to input and calculate a nonresidential building for Nonresidential Prescriptive compliance (Envelope, Lighting and Mechanical) in EnergyPro. For further information on nonresidential zoning and modeling techniques, see Nonresidential Compliance Modeling Techniques. Running EnergyPro includes step-by-step instructions for working through the program for any type of building.

NOTE: Certain inputs are treated differently within the program depending upon which set of standards--residential or nonresidential--applies to the building being modeled. See the Building Tree and Libraries for detailed information on each program input.

We will use the software's NonRes Sample file that comes with the program as a model for this tutorial. *NonRes Sample.bld* is a **mixed occupancy, nonresidential building.** The two-story sample building is made up of three area categories: an office and a retail space on the ground floor, and a restaurant above the retail space. You may use the procedures listed here in two ways:

- ☐ **For practice:** Open the *NonRes Sample* file and give it a name of your choice, to use as a practice file. Following the step-by-step procedures listed here, move through the sample input for the initial elements. Make the few minor input changes to identify the file as yours. Next, follow the instructions to delete the first Zone element of the Office Mechanical System, the Office Zone, and then insert an Undefined Zone and re-input the Office data from scratch. (The other two systems, Retail Mech System and Restaurant Mech System, will remain intact.) After you have completed Office Zone input and viewed the input for the other two systems, run calculations. Compare your calculation Results for the whole building to the Results of the existing *NonRes Sample* file. Check your practice file input against that of the existing file if there are discrepancies.
- ☐ **To follow along:** Open the *NonRes Sample* file and follow along on-screen as you read the text here.

The step-by-step procedures listed here assume you are using the **for-practice** method, but apply equally well should you choose to simply follow along with the existing file on-screen.

Use the Arrow buttons located either at the top of the Help screen or the bottom of each page to advance through the tutorial.

Text in [brackets] indicates that a [drop-down list] or [library] will be displayed from which you make a selection.

Text in (parentheses) contain directions.

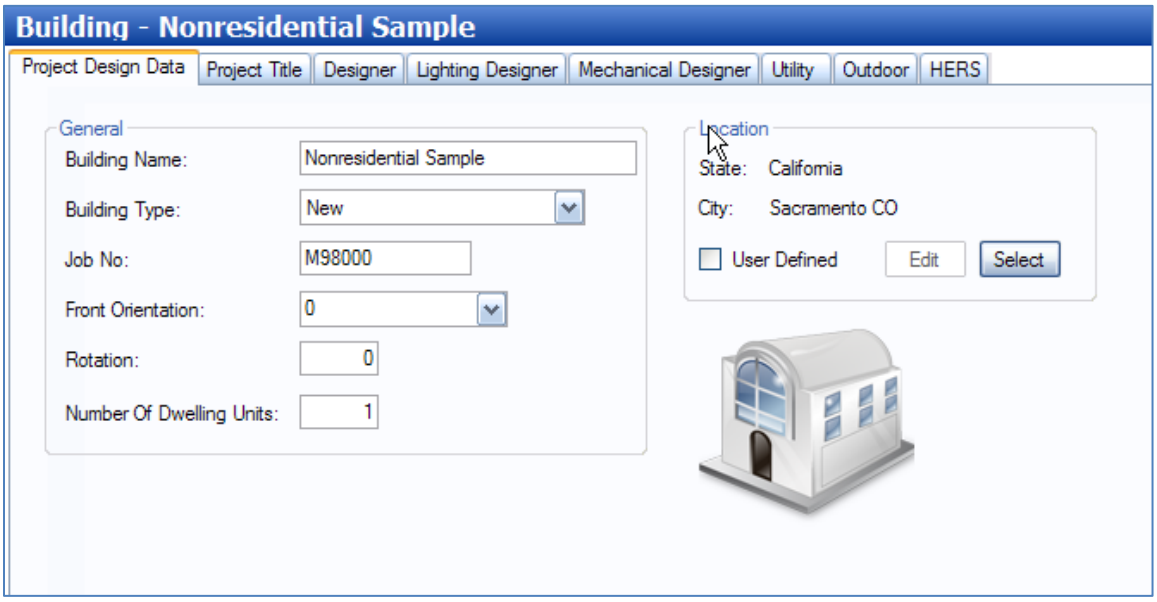
***All data inputs are shown in bold italics*.**

Data previously input is in *underlined italics*.

Practice data to input is shown in *blue italics*.

1. To begin, select **File/Open…** from the Main Menu. Select *NonRes Sample.bld*. Immediately choose **File/Save As…** and give the file a new name. The data you enter will be in your practice file, not the sample file that comes with the program.
2. Click on the Building Element icon named **Nonresidential Sample** to open the first element of the Building Tree.
3. Select **View/Expand Tree** to display the entire existing Building Tree for the sample building with any element selected/highlighted..

Editing the Building Element (NR Sample)



The first tab in the building element Nonresidential Sample is **Project Design Data**. Move from one entry to the next with the mouse or the <Tab> key. If you are practicing, write over the existing input with the data ***in blue***. Leave the remaining inputs in place.

1. **General**

   Building Name: ***NonRes Sample Practice***

   Building Type [from drop-down list]: ***New***

   Job Number: ***(your choice)***

   Front Orientation [from drop-down list or keyboard input]: ***0 (North)***

   Rotation: ***0*** degrees

   Number of Dwelling Units: ***1***

2. **Location**

   [from Location Library]: ***Sacramento CO***

3. Click on the next tab, **Project Title.** Input:

   Project

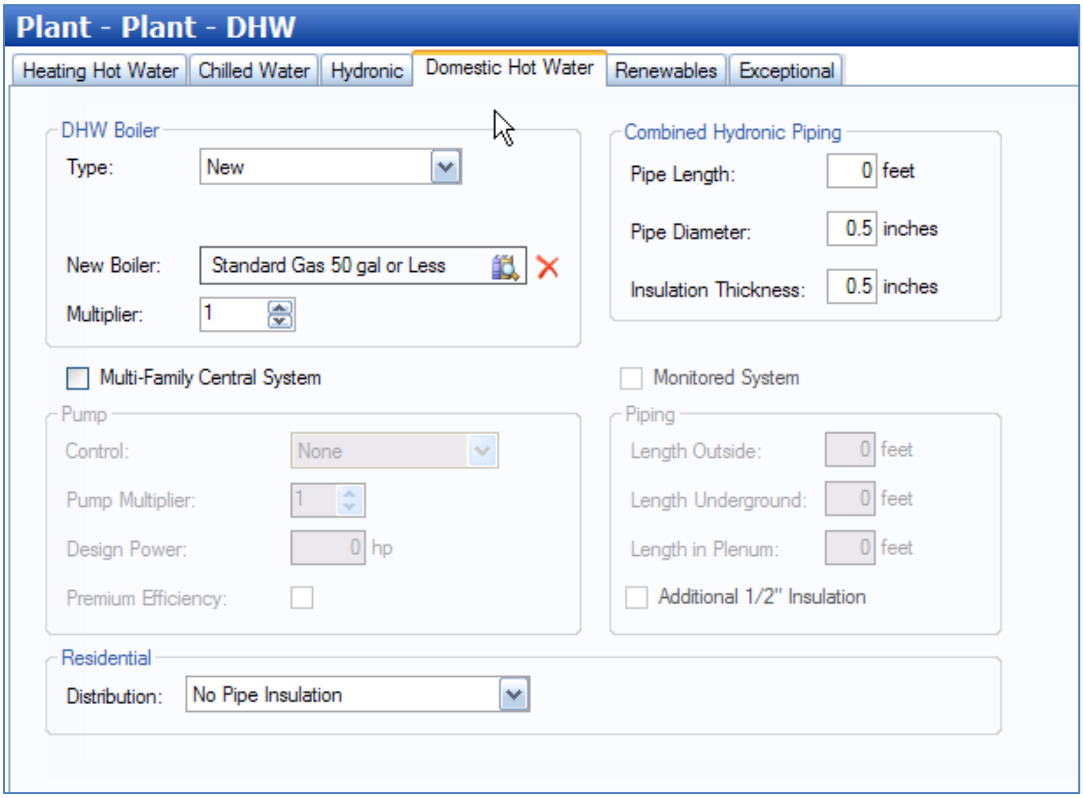
   Name: ***NonRes Practice*** This is the name that appears on report forms.

   The names and addresses for the designers affiliated with the project are entered in the **Designer**, **Lighting Designer** and **Mechanical Designer** tabs. This sample file already contains this information.

4. The **Utility, Outdoor and HERS tabs** are not used in this example.

You have completed data input for the Nonresidential Sample Building element. Click on the Plant element, Res DHW to continue.

Editing the Plant Element (NR Sample)



Click on the Plant element, Res DHW, if you haven't already, to access inputs for the Nonresidential sample building's Domestic Hot Water (DHW) features. .

1. The first tab in the dialog box is **Heating Hot Water**. Although there is no Boiler in your sample building, use this tab to name the Plant. For this sample:

   Plant Name: ***Plant - DHW***

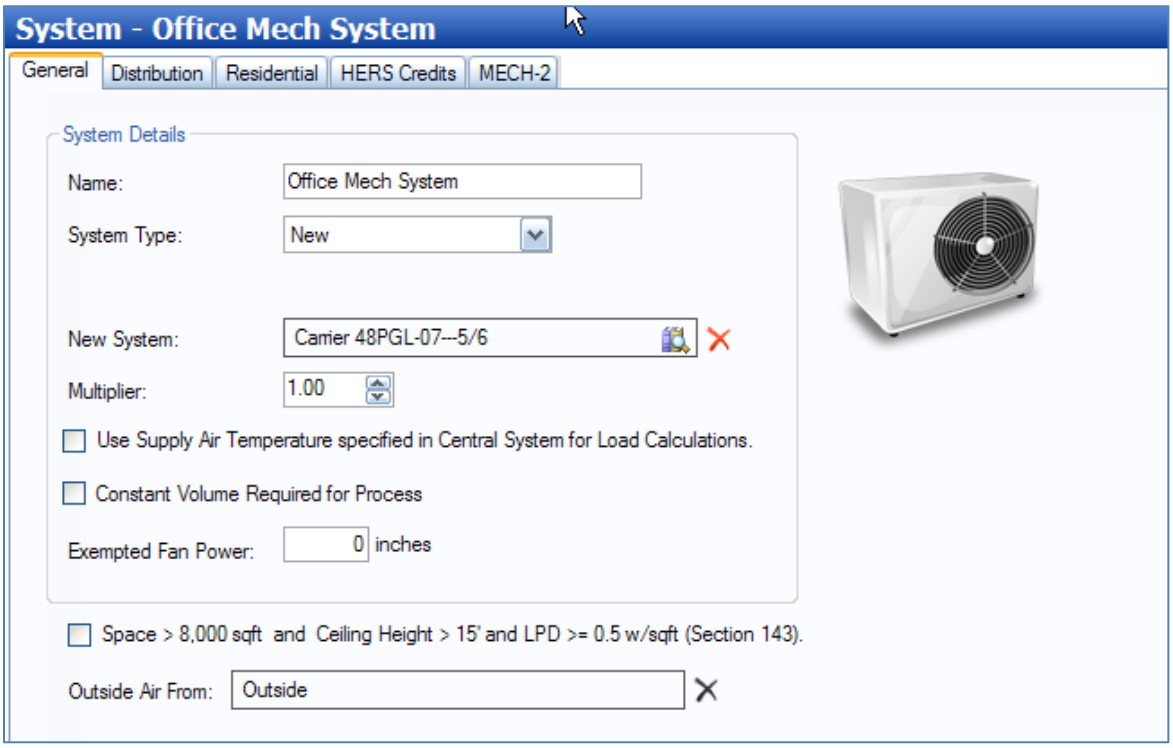
2. Click on the tab **Domestic Hot Water** to view the DHW system characteristics.

   Leave all DHW entries at their current values.

   You will not use the other Plant tabs (Chilled Water, Hydronic, Renewables and Exceptional systems) in this example.

2. Click on the System element, Office Mech System to continue..

Editing the System Element (NR Sample)



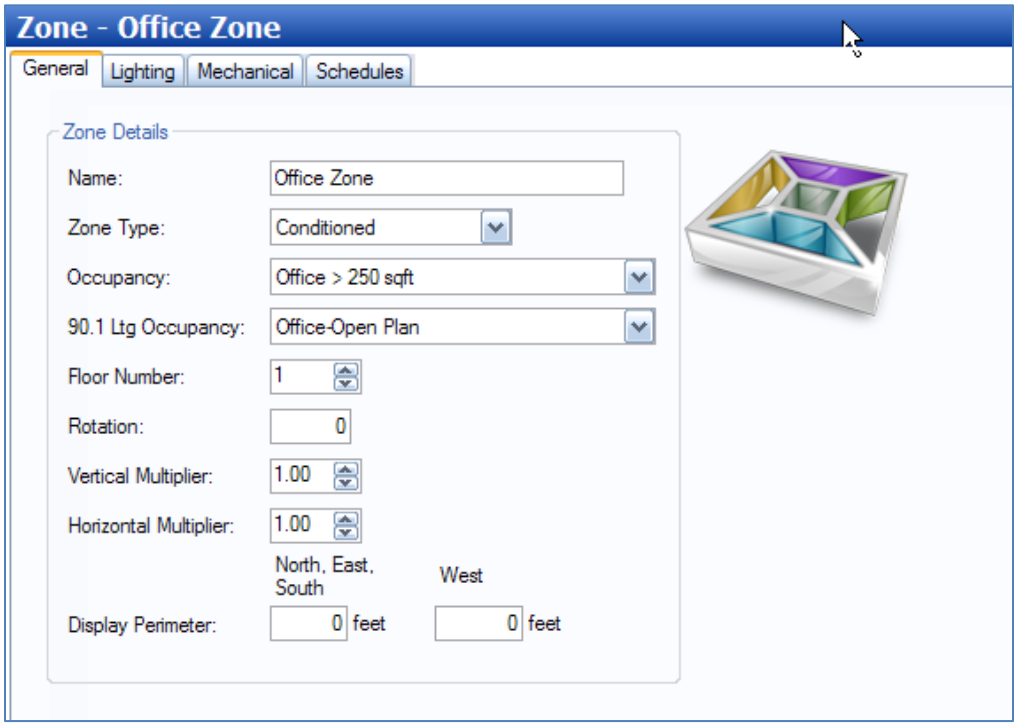
Move past the first System, Retail Mechanical System **Element**, to click on the Office Mechanical System **Element**, if you haven't already, for this portion of the tutorial.

1. The Office Mechanical System (Heating, Ventilation and Air Conditioning) has already been defined. Compliance rules apply to how you aggregate different zones into a single HVAC System. These rules and related design issues are discussed in Nonresidential Compliance Modeling.

NOTE: If this were an actual building you were entering from scratch, you would probably wait to choose a **System** until after you had entered all the building envelope features and run Load Calculations to determine sizing for HVAC unit(s). In this sample building file, all HVAC units have already been selected.

2. The HVAC selection is a Packaged DX from the default Central System Library. You can review the HVAC System details in the Central System Library.
3. Leave all inputs at their default settings
4. Now you will edit the Zone Element Office Zone

Editing the Zone Element (NR Sample)



If you are just following along, skip the next two steps. Also skip <u>all</u> instructions to add or insert elements. Instead, simply double-click on the element being discussed to view input.

<u>Deleting the Office Zone and its sub-elements for practice.</u>

1. Click on Office Zone, if you haven't already. Click the right mouse button, select **<u>D</u>elete**.
2. To create a new Office **Zone,** highlight the Office Mechanical System element, click the right mouse button, and select **<u>Add Zone.</u>** An Undefined Zone element appears below the Office Mechanical System.
3. Click on the new **Undefined Zone** to define the General, Lighting, and Mechanical Zone information, and to set Schedules for the zone. Only the **General** tab is shown here.

   On the **General** tab, input:

   Name: ***Office Zone***

   Occupancy [drop-down list]: ***Office >250 sqft.*** This is an area category occupancy; do not select Complete Building Office from the drop-down list by mistake. The software will automatically fill in the 90.1 Ltg. Occupancy field when you make your Occupancy selection.

   How to select the correct occupancy is an extremely important subject covered in the Building Tree: Zone Element *and in* Special Topics*. Read these sections carefully before selecting an occupancy for a real project.*
4. Leave the remaining General Zone inputs set to their default values.
5. Click on the next tab, **Lighting**. In this tab you will find two large sections: **Standard** Lighting, to determine what lighting level is used in the Standard (Budget) calculation; and **Proposed** Lighting, to determine how much lighting will be used in the Proposed (Actual) calculation.

Under **Standard** Lighting, select ***Use Standard LPD***. Enter nothing in the Override LPD box, as this project contains no tailored lighting component.

(If you were to choose Tailored here, you would be required to document the Tailored Allotment on the LTG-4 Form submitted with the compliance report; Tailored Lighting calculations would have to be performed for the entire permit area of the building.)

Under **Proposed** Lighting, select ***Use Installed LPD***. Because you did not select Override with Modeled Input, enter nothing in the Override LPD (Lighting Power Density) box.

(If you had chosen to Override with Modeled LPD, the zone would be modeled with the Override LPD regardless of what fixtures had been selected or what the Installed LPD value was.

If you are **following along**, you will note that the program has calculated the Installed LPD at 1.308 watts/sqft. If you are doing **practice** input, you can return to this tab after you have entered actual lighting fixtures under the Room element, to see that the LPD is indeed 1.308 watts/sqft.

6. Click on the **Mechanical** tab. Leave all Mechanical System Data entries set to their default values.
7. Click on the **Schedules** tab. In this tab you will find two sections.

   In the **Load Profiles** section, select:

   Lighting: ***CA Daytime Lighting***

   Process Lighting: Leave at default ***Undefined***

   Infiltration: ***CA Daytime Infiltration***

   Occupant: ***CA Daytime Occupants***

   Receptacle: ***CA Daytime Receptacle***

   Process: ***CA Daytime Process***

   DHW: ***CA Daytime Hot Water***

   In the **HVAC Operation** section, select

   Fan: ***CA Daytime Fans***

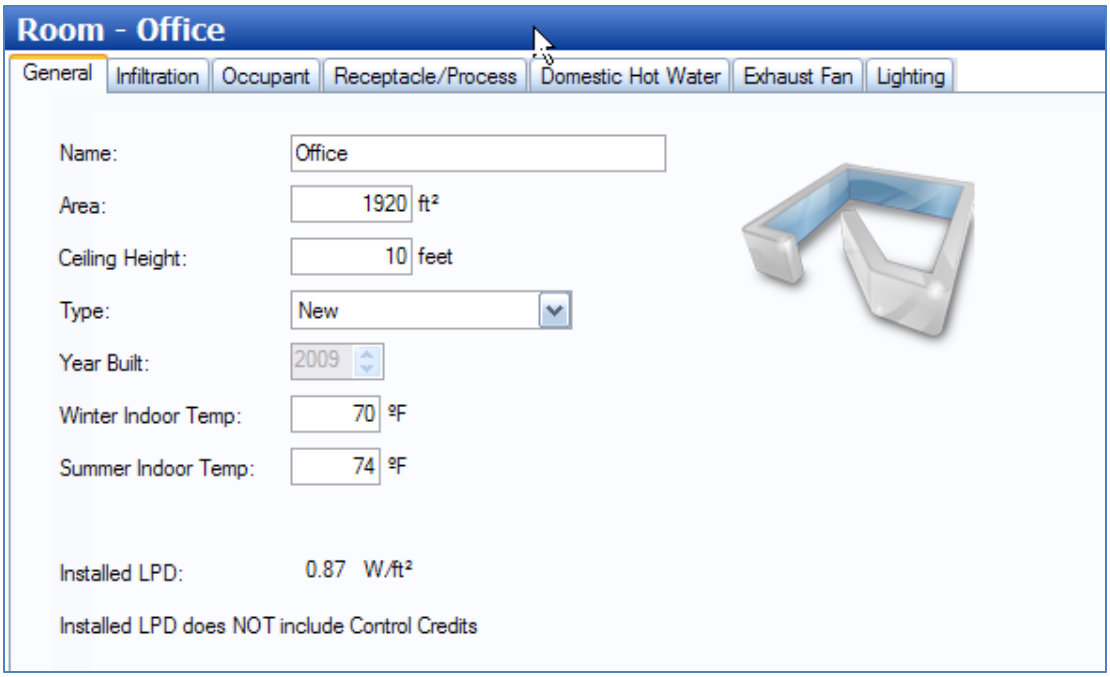
   Heating: ***CA Daytime Heating***

   Cooling: ***CA Daytime Cooling***.

   In most cases you do not need to define anything in the Schedules Tab.

You have completed zonal data input for the Office Zone **Element**. Next you will add a Room **Element** to this Zone.

Editing the Room Element (NR Sample)



1. Now you will Add a Room **element** to the Office Zone **Element** by clicking on the Office Zone, then right click and select **Add Room**
2. Click on **Undefined Room** to define the information specific to the building at this level. In this case, there is no need to list the zone by rooms; the data you input under Room will apply to the whole Office Zone.
3. The **General** tab is the first tab displayed. Input:

   Name: ***Office***

   Area: ***1,920*** ft² (178.4 m²) This is the total gross area of the Room/space being modeled, measured from the outside surface of the exterior walls.

   Ceiling Height: ***10*** feet (3.05 meters). This value is used to calculate the volume of the room.

   Leave the rest of the inputs at their default values.
4. The next tab is titled **Infiltration**. Leave inputs set to their default values.
5. Click on the next tab, **Occupant**. In the **Nonresidential** section leave inputs at their default values

   Occupant Density: ***100*** ft²/occupant (9.29 m²/occupant)

   Occupant Sensible: ***250*** Btuh/occupant (73.3 W/occupant)

   Occupant Latent: ***200*** Btuh/occupant (58.6 W/occupant)

   Ventilation: ***15.0*** cfm/occupant (7.1 L/s/occupant)
6. Click on the next tab**, Receptacle/Process**. The equipment (receptacle) power density is used only in NR Loads. This value is fixed for compliance calculations. The Process Sensible and Process Latent loads are used in the compliance calculations but must be documented.

   Receptacle

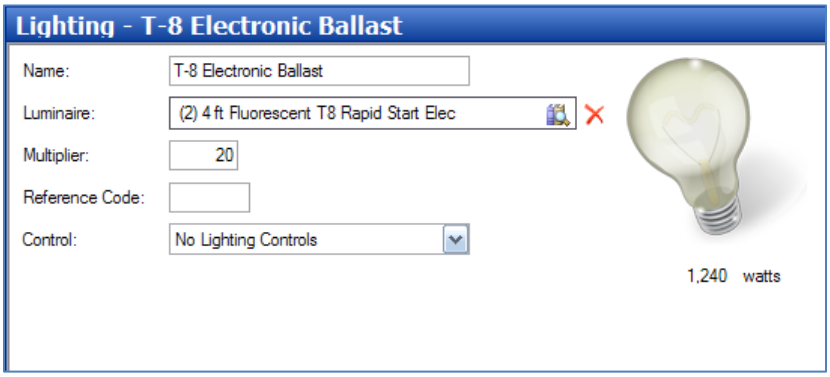
   Sensible Heat: ***1.50*** watt/ft² (16.14 watt/m²)

   Latent Heat: ***0*** watt/sqft (0.0 watt/m²)

   There are no **Process Equipment or Lighting** loads in this area. Leave default of zero.

7. Skip the next three tabs, **Domestic Hot Water, Exhaust Fans, and Lighting**; they do not apply to this job.
8. You have completed your entries for the Office Room **Element**.
9. At this point you have a choice of Building Tree elements under the level of the Room element. Highlight the Room element, click the right mouse button and select **Add**. The list of new components drops down and you can choose your next component by highlighting them one at a time, as we will do in the next part of this example.

Editing the Lighting Element (NR Sample)



Now you will **Add** a Lighting **Element** to your Room **Element,** Office by clicking on the Office **Element** then right clicking and then selecting **Add** and then selecting the Lighting component or highlight it and click. The Lighting **element** is inserted under the Room **element.**

1. **Lighting** input:

   Name: ***Lighting, Office***

   Luminaire: [Luminaire Library]: ***2 Lamp 4 ft T8 Rapid Start Elec***

   Multiplier: ***20***

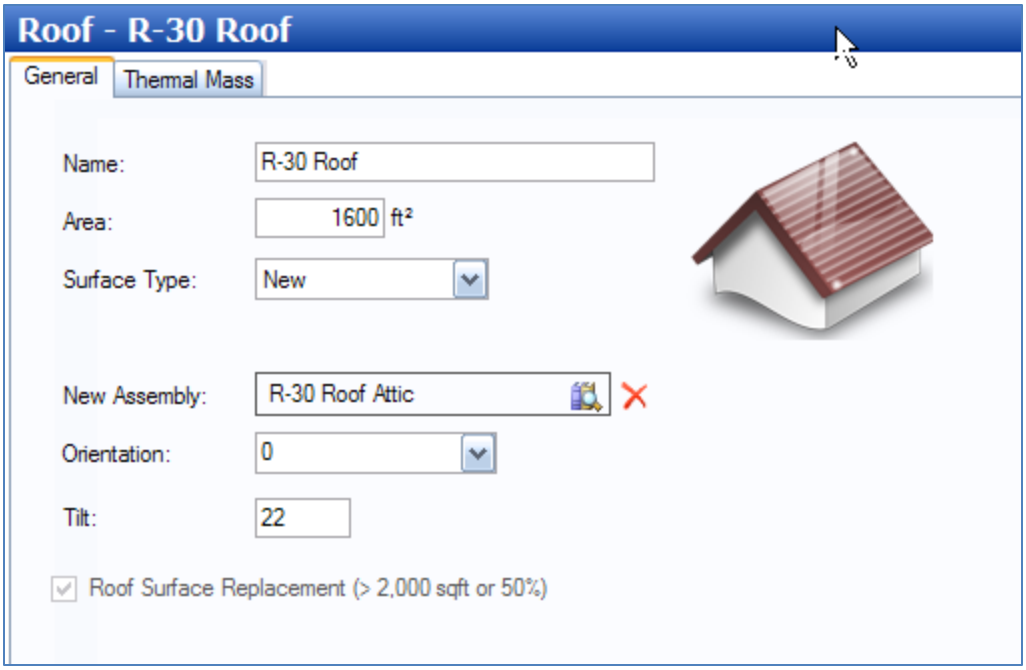
   Reference Code: ***A-1.*** This entry is the luminaire code on forms LTG-1 (part 2 of 2) and LTG-2.

   Control [drop-down]: ***Occ Sensor<=250 sqft***

You have completed inputs for Lighting, Office.

To continue adding elements to this Room **Element,** each new one **below** the last, highlight the element and, using the right mouse button, select Add. In this example, highlight the **Room** Element, **Office ,** click the right mouse button and select **Add**. Choose **Roof** from the Components list. It will be added under the Lighting Element you just completed.

Editing the Roof Element (NR Sample)



If you haven't done so already, highlight the Room Element, Office , click the right mouse button and select **Add**. Choose **Roof** from the Components list. It will be added under the Lighting Element you just completed.

1. Click on the Roof element. Input:

   Name: ***R-30 Roof***

   Area: ***1,600*** ft² (148.6 m²)

   Surface Type: ***New***

   New Assembly [Assembly Library]: ***R-30 Roof Roof Attic***

   Orientation [drop-down list or user input]: ***0*** (leave at default value)

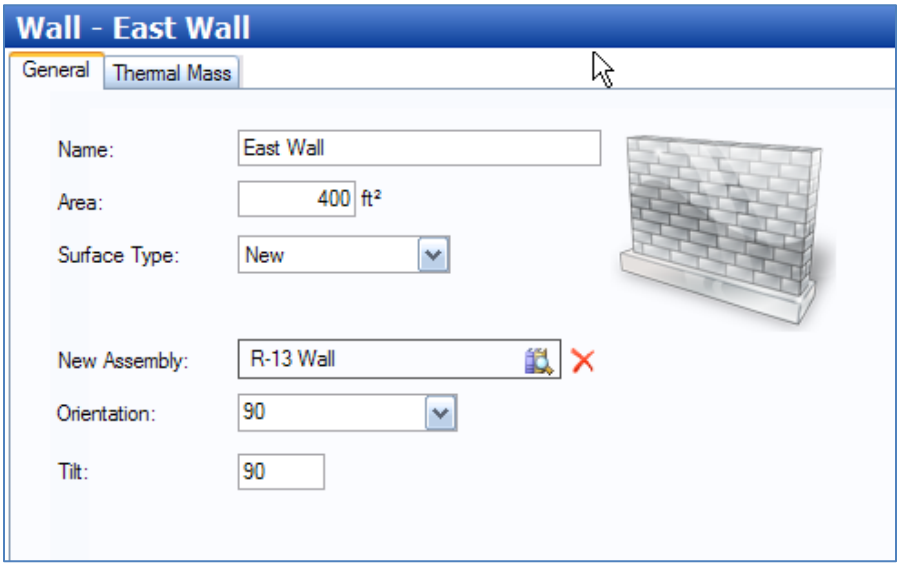
   Tilt: ***22*** degrees

   (There are no skylights in this building. If there were, you would define the Skylight element by highlighting the Roof element, clicking the right mouse button, and Inserting a Skylight.)

2. The **Thermal Mass** tab is not used in this example.

You've completed the Roof **Element** and now you will keep adding elements to the Room **Element**, Office using the instruction at the end of the **Editing the Lighting Element** section.

Editing the Exterior Wall Element (NR Sample)



Click on the Room **Element**, Office then right click and select **Add** and then select **Exterior Wall.** Click on the Wall Element, Exterior Wall. On the **General** tab input:

Name: ***East Wall*** (We are working in a clockwise direction around the building, N, E, S, W. The North wall of the retail space is a shared wall with the Retail space and is thus not shown here.)

Area: ***400*** ft² (37.2 m²)

Surface Type: ***New***

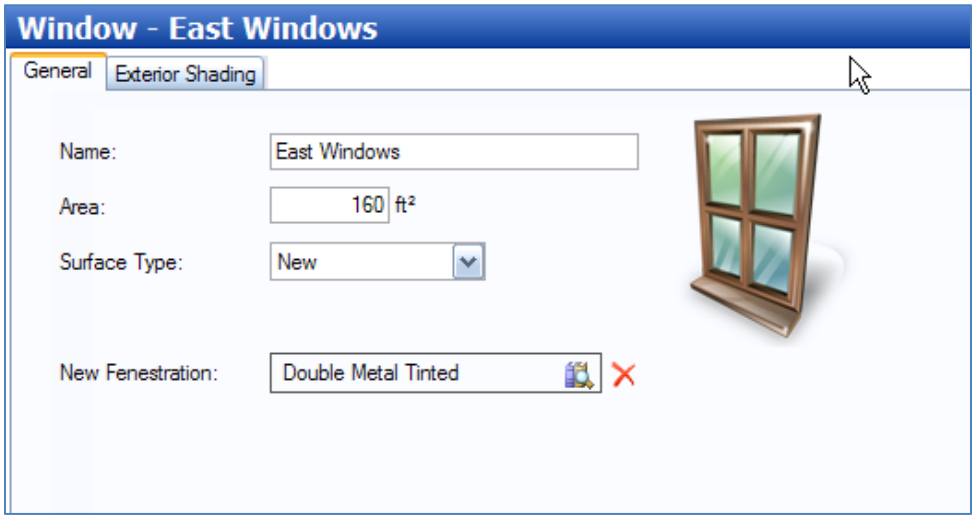
New Assembly [Assembly Library]: ***R-19 Wall***

Orientation [drop-down list or user input]: ***East*** (The program will change this to 90 degrees on-screen.)

Tilt: ***90*** degrees

2. You have completed input for the East Wall.
3. You may insert two types of **sub-components** for each wall, as applicable: **Windows** and **Doors**. (Doors or portions of doors made of glass are input using the Windows element, as shown under the Retail System.) With the Exterior Wall element highlighted (East Wall in this example), **Insert a** Window element under the East Wall.

Editing the Window Element (NR Sample)



With the Exterior Wall **Element**, East Wall highlighted, right click and select **Add Window**

1. Click on **Window**. The **Window** tab is displayed. Input:

   Name: ***East Windows***

   Area: ***160*** ft² (14.9 m²)

   Surface Type: ***New***

   Fenestration: [Fenestration Library]: ***Double Metal Tinted***

2. **Exterior Shading tab**. Leave set to ***Bug Screen (same as None.)*** Leave all other inputs set to default values.

Editing the Remaining Walls and Windows (NR Sample)

1. Click on the Room **Element**, Office then right click and select **Add** and then select **Exterior Wall.** Click on the Wall Element, Exterior Wall. On the **General** tab input:

   Name: ***South Wall***

   Area: ***400*** ft² (37.2 m²)

   Surface Type: ***New***

   New Assembly: [Assembly Library]: ***R-19 Wall***

   Orientation [drop-down list or user input]: ***South***

   Tilt: ***90*** degrees

2. With the Exterior Wall **Element**, South Wall highlighted, right click and select **Add Window**

   Name: ***South Windows***

   Area: ***160*** ft² (14.9 m²)

   Fenestration: [Fenestration Library]: ***Double Metal Tinted***

Exterior Shading tab. Leave set to ***Bug Screen (same as None.)*** Leave all other inputs set to default values.

3. Click on the Room **Element**, Office then right click and select **Add** and then select **Exterior Wall.** Click on the Wall Element, Exterior Wall. On the **General** tab input

   Name: ***West Wall***

   Area: ***400*** ft² (37.2 m²)

   Surface Type: ***New***

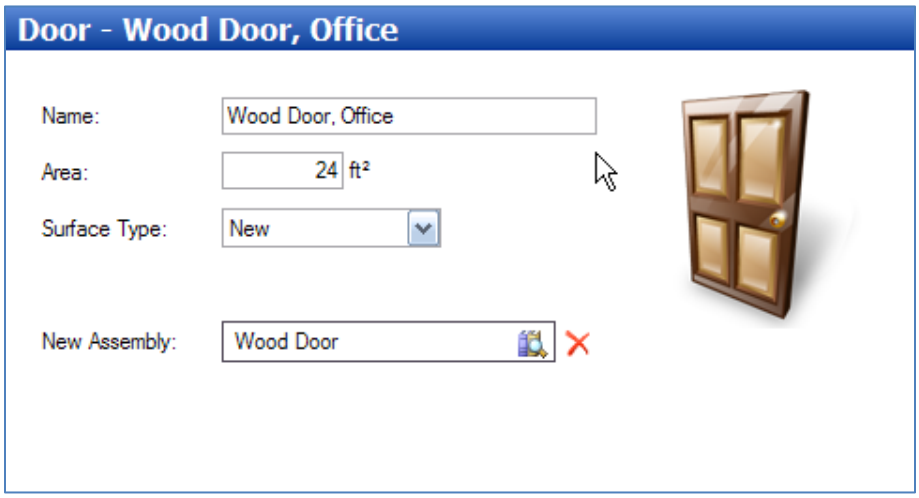
   New Assembly: [Assembly Library]: ***R-19 Wall***

   Orientation [drop-down list or user input]: ***West***

   Tilt: ***90*** degrees

4. You have completed the input for the Wall **Elements** for the Office Zone. Next you will Add a door to the West Wall

Editing the Door Element (NR Sample)



Now you will insert another **sub-component,** a door. With the West Wall **Element** highlighted, click the right mouse button and select **Add Door**. The Door **Element** will be Added under the West Wall.

1. Click on the **Door** element to input:

   Name: ***Wood Door, Office***

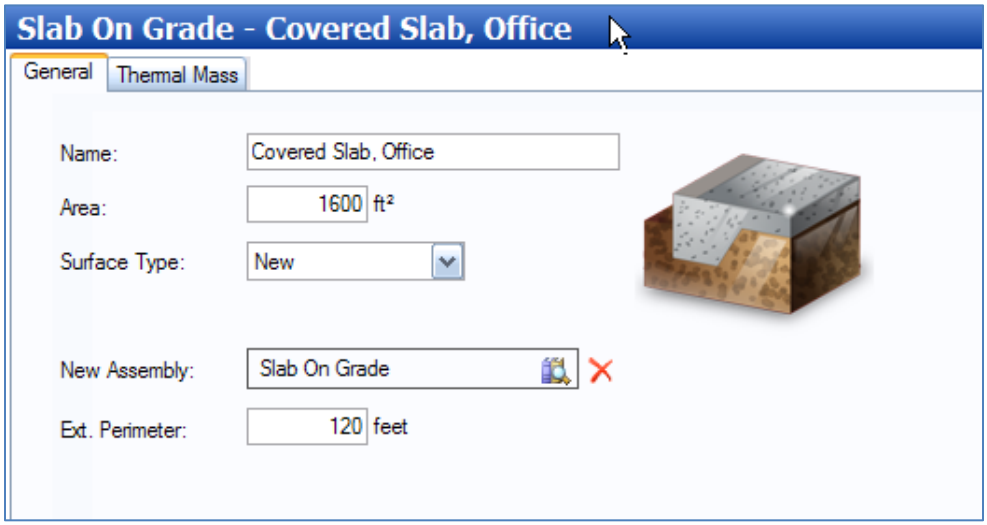
   Area: ***24*** ft² (2.2 m²)

   Surface Type: ***New***

   New Assembly: [drop-down list]: ***Wood Door***

2. You have completed the door for the West Wall. Next you will Add a Slab on Grade **Element** to the Room **Element**, Office.

Editing the Slab Element (NR Sample)



Click on the Room **Element**, Office then right click and select **Add** and then select **Slab on Grade.**

1. Click on the Floor Element, Slab on Grade, input:

   Name: ***Covered Slab, Office***

   Area: ***1600*** ft² 148.6 m²

   Surface Type: ***New***

   New Assembly: [Assembly Library]: ***Slab on Grade***

   Ext. Perimeter ***120*** feet (36.6 meters)

2. **You have completed practice data input for the Office Zone.**

Continue working your way through the Retail and Restaurant systems and their sub-elements, viewing the input.

Note that the **Retail area** of the building has glass entry doors (to the north) which are entered with the Windows element. Also note that it has no Roof input because it is below conditioned space, the Restaurant area. It shows no south wall because it shares that wall with the Office.

Note that in the **Restaurant** area, in the **Room** element under the **Receptacle/Process** tab, there is a Process Load of 1.5 watts/square foot; the other Room elements have no process loads.

Now that the Building Tree is complete, **Save** the file and run calculations.

Running Calculations (NR Sample)

Initiate calculations from the Calculations list in the lower-left window pane. Once you select which calculations to run for a particular project, you can use the Calculate button on the toolbar. The first time you

run calculations for any file, you must set the calculation Options. Once Options are set, click on the Calculate button to initiate Calculations in one step.

1. Select Calculations from the choices in the lower-left window pane. Please Note: You may only run the types of calculations you have purchased. Select User Information from the Help menu to verify the status for each module.
2. Select (check the checkbox) the NR Prescriptive calculation.

The applicable boxes have been checked for you: Envelope, Indoor Lighting, Outdoor Lighting, and Mechanical.

NOTE: If you have purchased some, but not all the Prescriptive modules, check only the options you have purchased.

3. Select the **Loads** calculation. Leave the inputs set at their default values for this calculation.
4. For Winter Design Conditions, ***Median of Extremes*** has been selected and the ***0.5%/0.4% Design Data*** for ***Summer Design Conditions*** has been selected. The box Use Design Wet Bulb (not Mean Coincident Wet Bulb) has been checked. Under Design Day for Schedules, ***Ignore (use 100%)*** has been selected.
6. Now you are ready to run Calculations. Select the Calculate button on the toolbar.
7. **EnergyPro** displays results for each type of calculation you have selected in a tabbed format in the bottom-right window pane

The Nonresidential Sample Building complies with the *Standards* using the Prescriptive Method, as shown in the NR Prescriptive Results box. The envelope complies since the **Proposed TDV Energy** is less than the **Standard TDV Energy**. The **Proposed Indoor Conditioned, Indoor Unconditioned, and Outdoor Lighting LPDs** are less than the **Standard Lighting LPDs**. The **Mechanical System** has been sized to accommodate the cooling load without being oversized (heating is necessarily oversized because of availability of units, but does not affect compliance); and the **Proposed Fan Power** is less than **Standard**.

Preparing and Printing Reports (NR Sample)

1. You may either use the Report Wizard to prepare a report for printing or select Reports from the choices in the bottom-right window pane. Select **File/Report Wizard…** from the Main Menu or click on the Report Wizard icon in the toolbar. A wizard welcomes you to the Select Report Type dialog box.
2. Select California Code (Title 24) Prescriptive and move to the next box from the list of Nonresidential reports and and Next to continue.
3. Select the Forms you wish to include in your report by checking (clicking on) the appropriate boxes, then select Next. Note those that have been selected for this sample.
4. To end: In the last box, Report Complete, click Finish to close the Wizard without viewing the report, or the Print Preview button to view your report. It is ready to print, unless you choose to make changes after viewing the Report. You can page up or down through the Title 24 Report that has been prepared for this sample building.

Residential Sample Building

This section illustrates how to input and calculate a residential building for compliance using the software. The sample building is a single-family, detached, two-story dwelling which complies with the residential standards using EnergyPro's Residential Performance calculation module. For further information on residential zoning and modeling techniques, see Residential Compliance Modeling Techniques. Running EnergyPro includes step-by-step instructions for working through the program for any type of building.

NOTE: Certain inputs are treated differently within the program depending upon which set of standards--residential or nonresidential--applies to the building being modeled. See the Building Tree and Libraries for detailed information on each program input.

We will use the software Res Sample file that comes with the program as a model for this tutorial. Res Sample.bld is a single family, detached, two-story dwelling. You may use the procedures listed here in two ways:

- ☐ **For practice:** Open the Res Sample file and give it a name of your choice, to use as a practice file. Following the step-by-step procedures listed here, move through the sample input for the initial elements. Make the few minor input changes to identify the file as yours. Next, follow the instructions to delete the 1st Floor Zone element, and then insert an Undefined Zone and re-input the 1st Floor Zone (and Room) data from scratch. After you have completed inputs, run calculations. Compare your calculation Results to the Results of the existing Res Sample file. Check your practice file input against that of the existing file if there are discrepancies.
- ☐ **To follow along:** Open the Res Sample file and follow along on-screen as you read the text here.

The step-by-step procedures listed here assume you are using the **for-practice** method, but apply equally well should you choose to simply follow along with the existing file on-screen.

Do not use the sample files that come with the program to create templates for future use. The sample files are designed to be used only as tutorials.

Use the Arrow buttons located either at the top left of the Help window or at the bottom of each page to advance through the tutorial.

Text in [brackets] indicates that a [drop-down list] or [library] will be displayed from which you make a selection.

Text in (parentheses) contain directions.

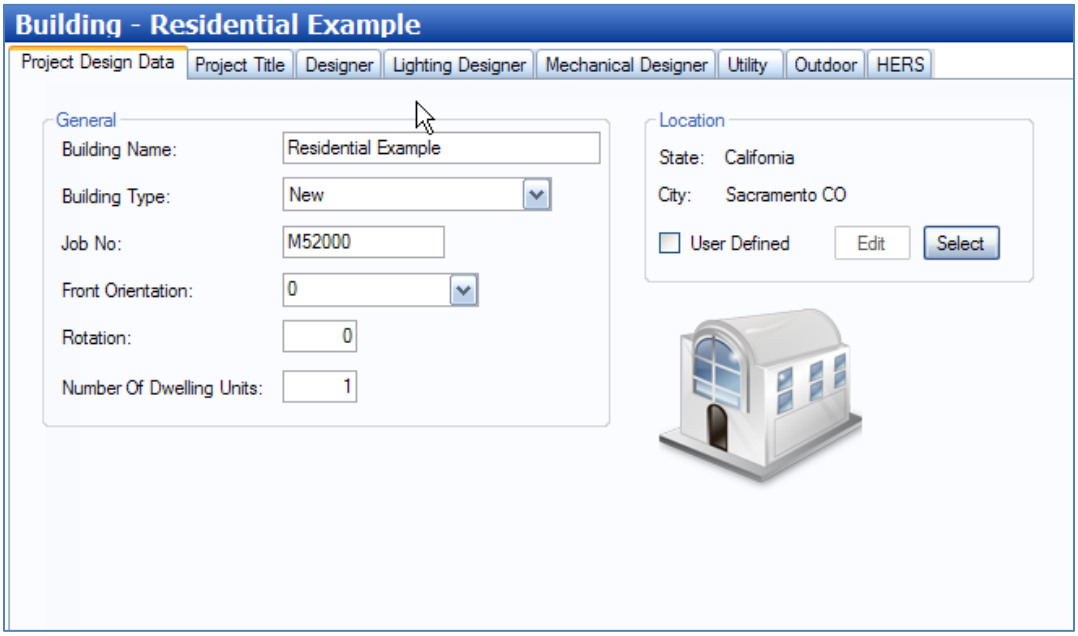
***All data inputs are shown in bold italics*.**

Data previously input is in *underlined italics*.

Practice data to input is shown in *blue italics*.

1. To begin, select **File/Open…** from the Main Menu. Select Res Sample.bld. Immediately choose **File/Save As…** and give the file a new name. The data you enter will be in your practice file, not the sample file that comes with the program.
2. Click on the Building Element named Residential Example for the sample building.
3. You can expand the entire Building Tree by clicking on **View/Expand Tree** with any building element selected/highlighted.

Editing the Building Element (Res Sample)



1. Click on the Building Element named Residential Example if you haven't done so already. The first tab in the building element is **Project Design Data**. Move from one entry to the next with the mouse or the <Tab> key. If you are practicing, write over the existing input with the data ***in blue***. Leave the remaining inputs in place.

   General

   Building Name: ***Residential Example***

   Building Type [from drop-down list]: ***New***

   Job Number: ***(your choice)***

   Front Orientation [from drop-down list or keyboard input]: ***0 (North)***

   Rotation: ***0*** degrees

   Number of Dwelling Units: ***1***

   Location

   [from Location Library]: ***Sacramento CO***

2. Click on the next tab, **Project Title**.

   Project

   Name: ***Sample Residence*** This name and address information appears on report forms.

   You can either leave the rest of the fields on this page as is or change them for your practice.

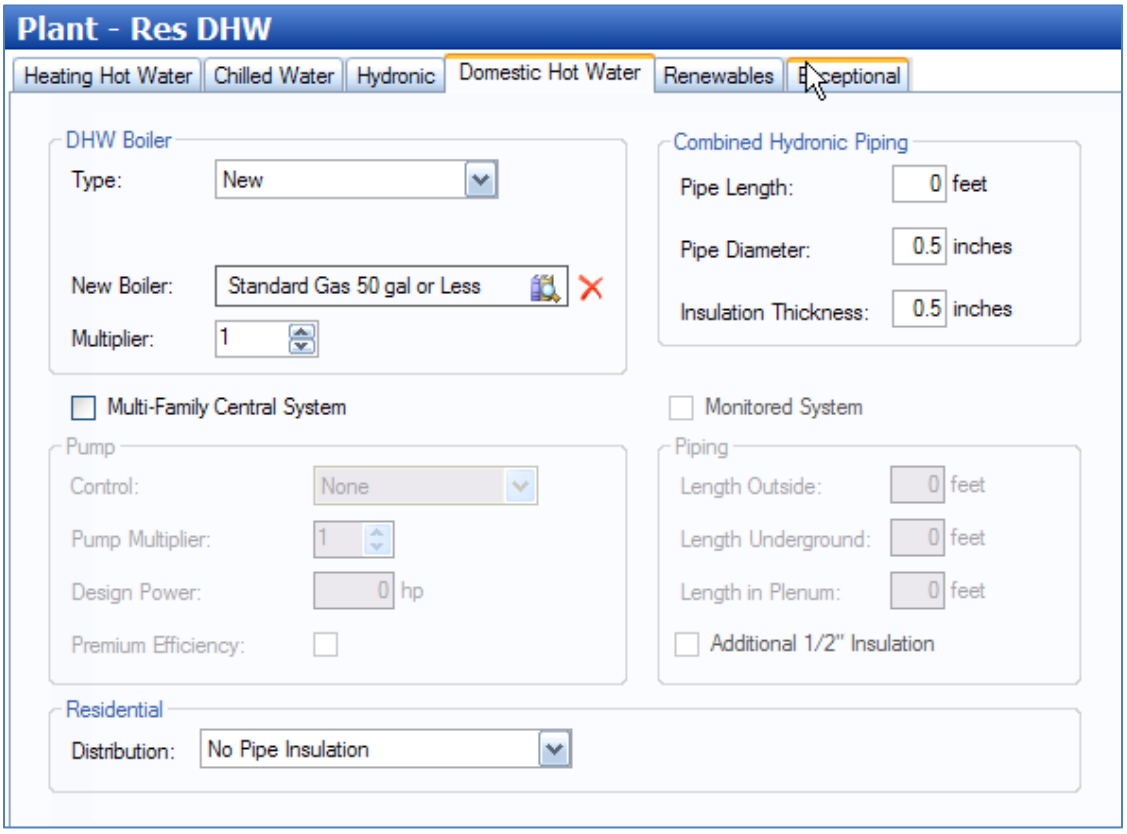
3. Click on the next tab, **Designer**

   The name and address for the designer affiliated with the project is already entered. (You do not use the other Designer tabs for residential buildings.)

4. The **Utility and Outdoor** tabs are not used in this example.

6. The HERS tab is used for HERS II and GreenPoint Rated calculations. We will not change any of the entries in this exercise, but you may wish to review the data and the requirements for the various entries.
7. You have completed data input for the Residential Example Building element. Click on the Plant element, Res DHW to continue.

Editing the Plant Element (Res Sample)

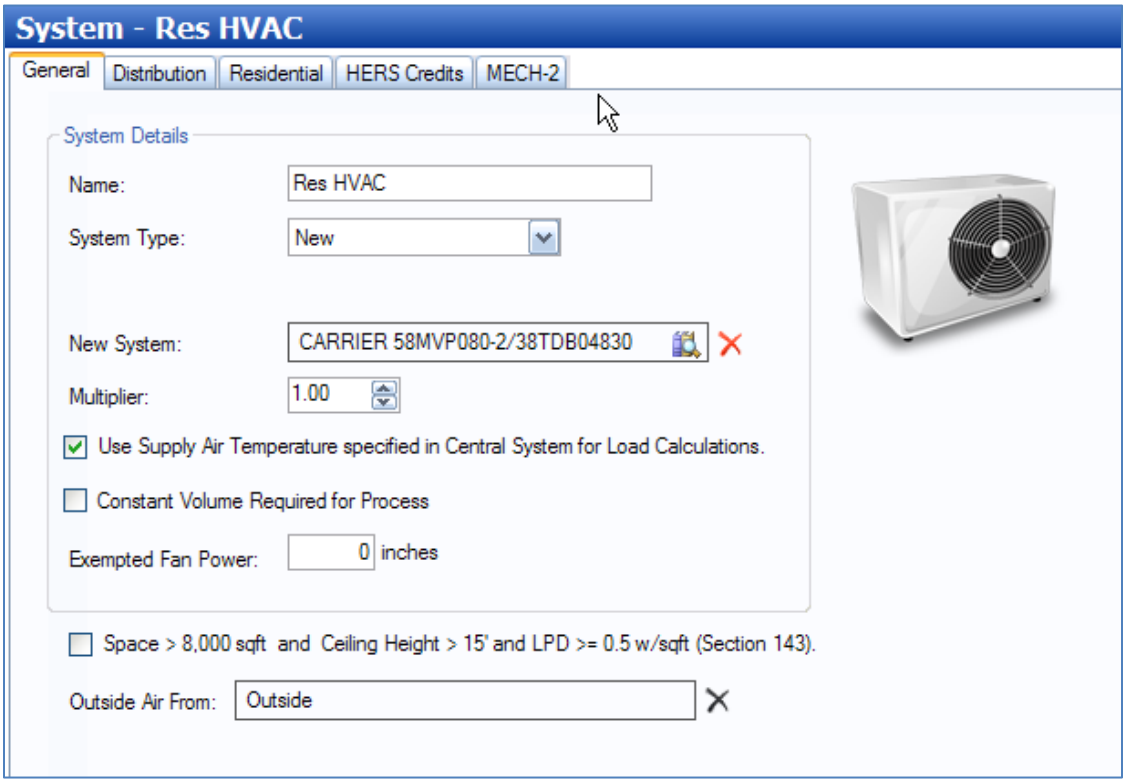


1. Click on the Plant element, Res DHW, if you haven't already, to access inputs for the residential sample building's Domestic Hot Water (DHW) features.
2. The first tab in the dialog box is **Heating Hot Water**. Although there is no Hot Water Boiler or Pump in your residential sample building (nor in most typical residential buildings), use this tab to name the Plant element you have modeled.

   Name: *Res DHW*
3. You will not use the remaining Plant tabs (Chilled Water, Hydronic, Renewables, and Exceptional) in this example. Refer to the Plant Element in the Building Tree for detailed explanations of these entries.
4. Click on the tab, **Domestic Hot Water** to view the DHW system characteristics.

   Leave all DHW entries at their current values.
7. Click on the System element, Res HVAC to continue.

Editing the System Element (Res Sample)



1. Click on the System Element, Res HVAC, if you haven't already, to view the HVAC System for this residence, which has already been defined. Compliance rules apply to how you aggregate different zones into a single HVAC system. These rules and related design issues are discussed in Residential Compliance

Note: If this were an actual building you were entering from scratch, you would probably wait to choose a System until after you had entered all the building envelope features and run Load Calculations to determine sizing for HVAC unit(s). In this sample building file, the HVAC unit has already been selected.

2. **General**

   You can review the HVAC System details in the Central System Library by clicking in the New System field. In this case we've selected a CARRIER system.

3. **Distribution**

   Review the data describing the HVAC distribution system (ducts). You will note that the duct insulation R-Value is less than the residential prescriptive minimum requirement. This will result in a penalty in the proposed building energy use.

4. **Residential**

   Leave all entries on this tab set at default values. As indicated, this building does not have a mechanical ventilation system installed.

5. **HERS**

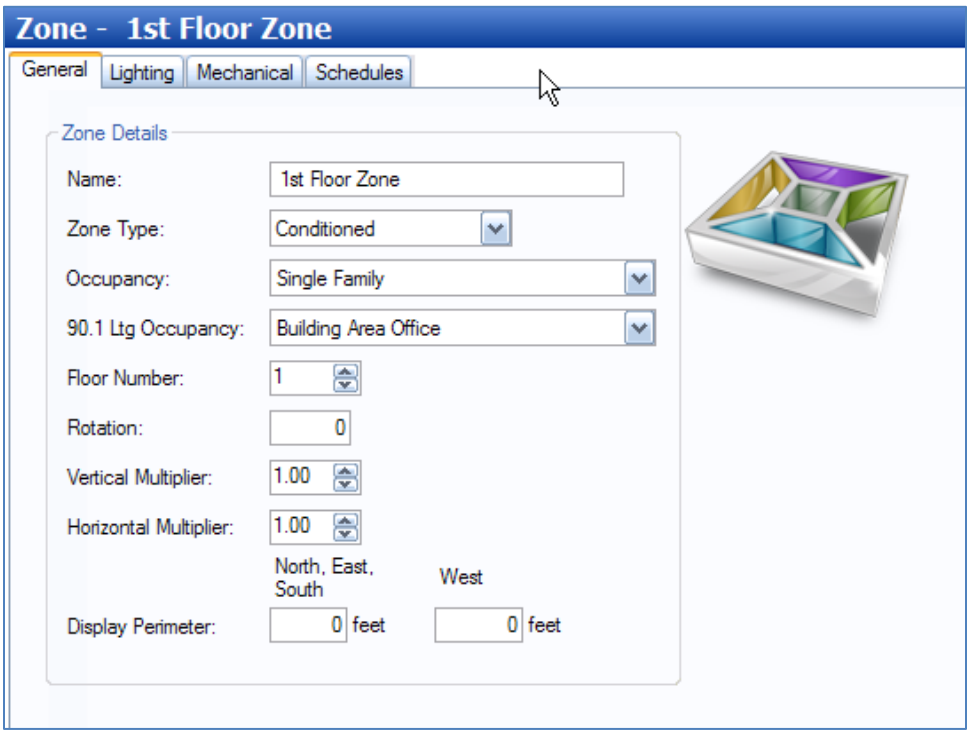
This project includes 11 measures that require field verification by a certified HERS Rater: five measures related to Title 24, and six additional measures related to HERS II ratings.

6. **MECH-2**

   This tab is used for nonresidential projects only.

You have finished reviewing the Res HVAC input. Next you'll edit the Zone Element, 1st Floor Zone.

Editing the Zone Element (Res Sample)



If you are just following along, skip the next two steps and skip all instructions to add or delete elements. Instead, simply click on the element being discussed to view input.

Deleting the 1st Floor Zone and its sub-elements for practice.

1. Click on the Zone Element 1st Floor Zone. Click the right mouse button, select **Delete**.
2. Create a new 1st Floor Zone **Element**, by clicking on the Res HVAC System element, click the right mouse button, and select **Add Zone** An Undefined Zone element appears below the Res HVAC System Element.
3. Click on the Undefined Zone **Element** to define the General Zone information. Only the **General** tab is used for residential buildings. You do not use the **Lighting, Mechanical or Schedules** tabs for residential buildings.

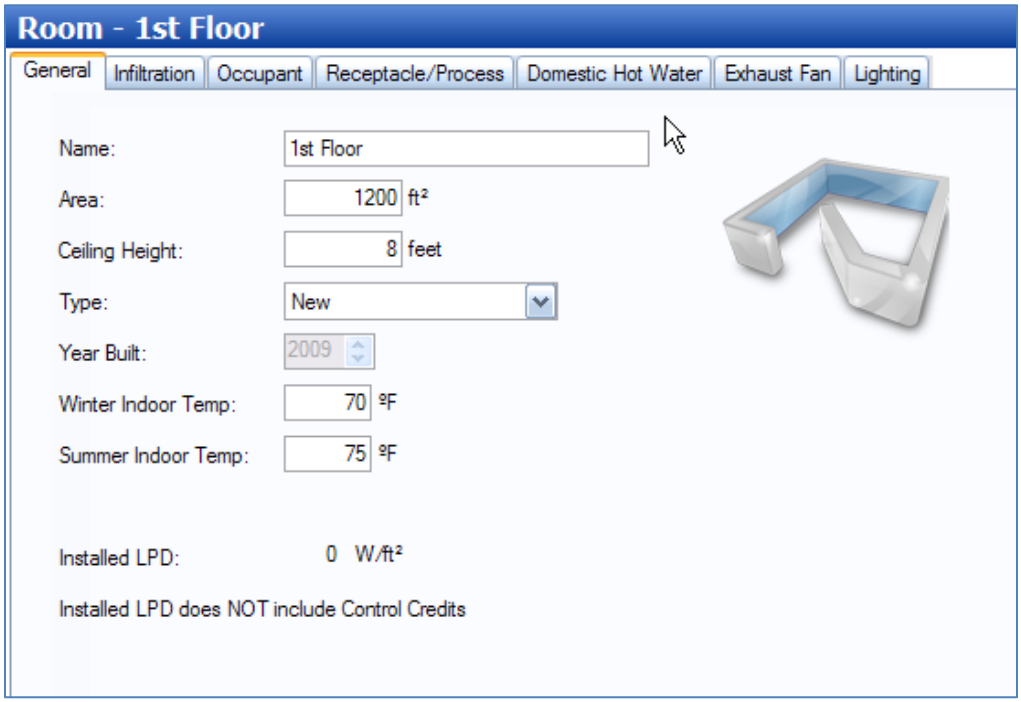
4... On the **General** tab, input:

Name: ***1st Floor Zone***

Occupancy [drop-down list]: ***Single Family***

5. Leave the remaining 1st Floor Zone inputs set to their default values. You have completed zonal data input for the 1st Floor Zone.
6. Next you'll add a Room **Element**

Editing the Room Element (Res Sample)



Now you will add a Room **Element** to the 1st Floor Zone **Element**

1. Right click on the 1st Floor Zone **Element**. Click on Add Room.
2. Click on the new element Undefined Room to define the information specific to the building at this level. In this case, there is no need to list the zone by rooms; the data you input under Room will apply to the whole 1st Floor.
3. The **General** tab is the first tab displayed. Input:

   Name: ***1st Floor***

   Area: ***1,200*** ft² (111.5m²). This is the total gross area of the Room/space being modeled, measured from the outside surface of the exterior walls.

4... Leave the rest of the inputs on the **General** tab at their default values.

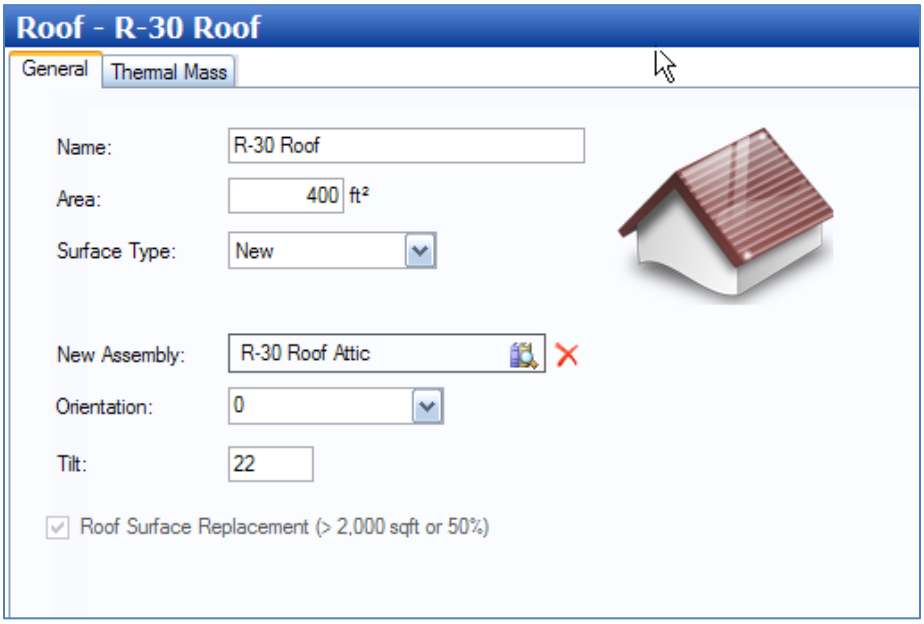
5... Leave all inputs in the remaining tabs set to their default values.

6... You have completed your entries for the 1st Floor Room **Element**.

7. At this point you have a choice of Building Tree elements under the level of the Room element. Click the right mouse button and select **Add**. The list of new components drops down. You add them one at a time.

Next you'll add a Roof **Element.**

Editing the Roof Element (Res Sample)



Now you will add a Roof Element to the 1st Floor Room Element

1. Click on the 1st Floor Room **Element** and right click. Highlight the **Add** and then click on **Roof**. The **Roof** element is now added under the Room element
2. Click on the Roof **Element**.
3. On the **General** tab input:

   Name: ***R-30 Roof***

   Area: ***400*** ft² (37.2 m²)

   Surface Type: ***New***

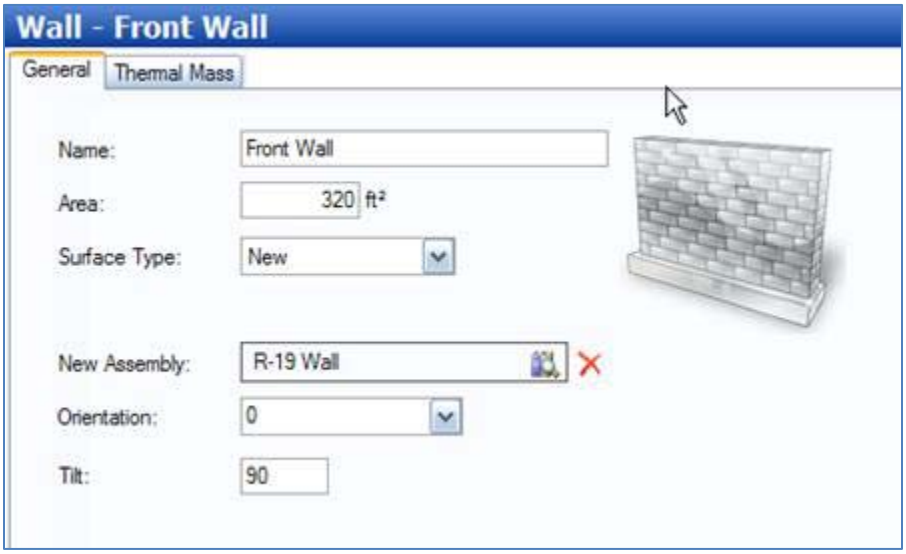
   New Assembly: [Assembly Library]: ***R-30 Roof Attic***

   Orientation [drop-down list or user input]: ***0*** (leave at default value)

   Tilt: ***22*** degrees
4. Leave the **Thermal Mass** tab inputs at their default values
5. (There are no skylights in this building. If there were, you would define the Skylight element by highlighting the Roof element, clicking the right mouse button, selecting **Add Skylight**.).

Next you will add an Exterior Wall **Element**.

Editing the Exterior Wall Element (Res Sample)



1. Click on the 1st Floor Room **Element** then right click and then select Add. Choose the Exterior Wall **Element** from the list. It will be added after the Roof **Element**. You may also use the Insert key to accomplish the same thing.
2. Click on the Exterior Wall **Element.**

   Name: ***Front Wall*** (We are working in a clockwise direction around the building, Front, Left, Back, Right, as viewed facing the front of the building.

   Area: ***320*** ft² (29.7 m²)

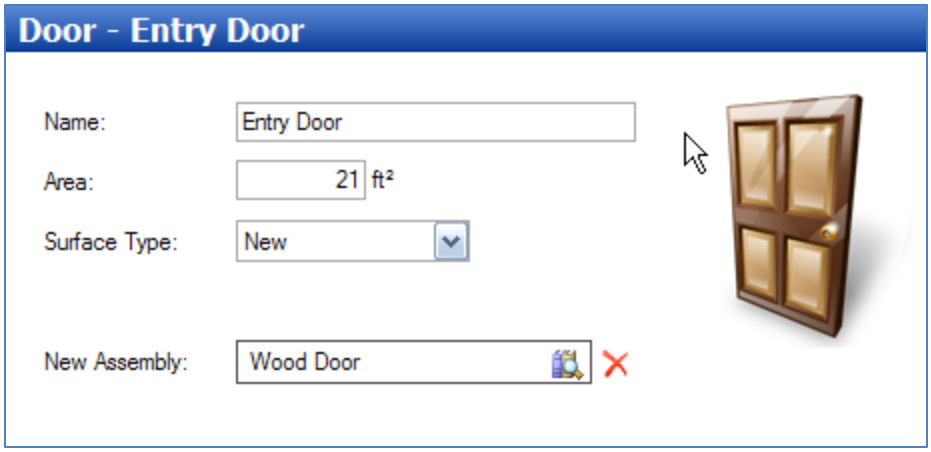
   Surface Type: ***New***

   New Assembly: [Assembly Library]: ***R-19 Wall.*** *(*Click on this field to select R-19 Wall from the Library and then click on *OK)*

   Orientation [drop-down list or user input]: ***0*** (leave at default value)

   Tilt: ***90*** (leave at default value)
3. Next **Add** two types of **sub-components, Windows** and **Doors,** for the Front Wall **Element**. (Doors or portions of doors made of glass are input as windows, using the Window element.) For this example, click on the Front Wall **Element** then right click and then highlight **Add Window.** Repeat these steps to **Add Door**
4. Next you'll edit the window and door you've just added to the Front Wall **Element**.

Editing the Door Element (Res Sample)



1. Click on the Door **Element** to input:

   Name: ***Entry Door***

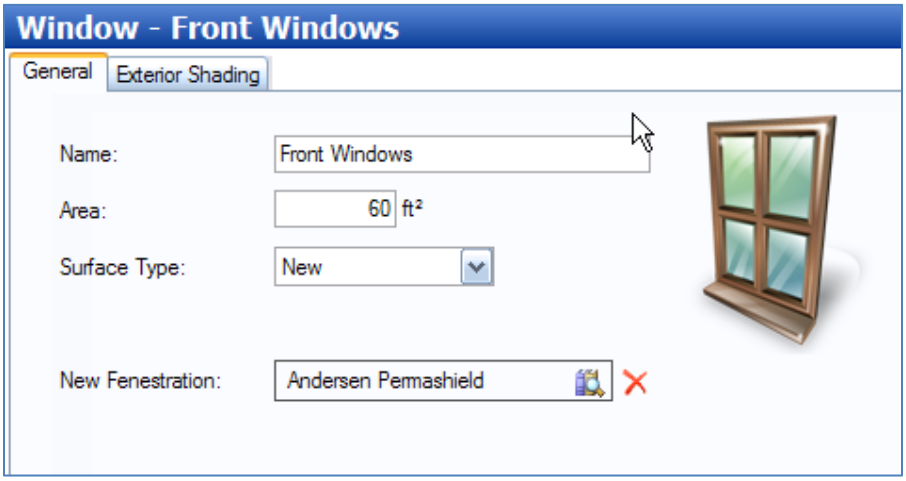
   Area: ***21*** ft² (2.0 m²)

   Surface Type: ***New***

   New Assembly: [Assembly Library]: ***Wood Door***

2. Next you'll edit the Window **Element** you just added.

Editing the Window Element (Res Sample)



1. Click on the Window **Element**. The **General** tab is displayed. Input:

   Name: ***Front Windows***

   (All windows of the same type can be combined in one value. Different window types on the same wall might be named to show their distinguishing features, e.g., Front Windows, Wood; Front Windows, Fixed; Front Windows w/Overhangs, etc.)

Area: ***60*** ft² (5.6 m²)

Surface Type: ***New***

New Fenestration [Fenestration Library]: ***Anderson Permashield*** ***(Click in this field to choose Anderson Permashield, then click on*** **OK)**

2. Click on the **Exterior Shading** tab. Leave the Shading Device set to the default selection: ***Bug Screen***

There are no overhangs or sidefins in this example.

NOTE: Model the Standard Bug Screen for glass doors, also.

Editing the Remaining Walls and Openings (Res Sample)

Now you will continue adding Walls and the Window and Door **Elements** that belong to each wall to the 1st Floor **Room Element** and inputting data.

1. Add to the, 1st Floor **Room Element,** another Exterior Wall **Element** by following instruction number 1 above under Editing the Exterior Wall Element. Click on the new wall to input on the **General** tab:

   Name: ***Left Wall***

   Area: ***240*** ft² (22.3m²)

   New Assembly: [Assembly Library]: ***R-19 Wall.*** *(*Click on this field to select R-19 Wall from the Library and then click on *OK)*

   Orientation [drop-down list or user input]: ***East***

   Tilt: ***90*** degrees

2. Add to the Left Wall **Element**, a Window **Element** by following the instruction number 3 above under Editing the Exterior Wall Element. Then in the **General** tab**,** input:

   Name: ***Left Windows***

   Area: ***40*** ft² (3.7 m²)

   New Fenestration [Fenestration Library]: ***Anderson Permashield*** ***(Click in this field to choose Anderson Permashield, then click on*** **OK)**

   Exterior Shading tab. Leave the Shading Device set to the default selection: ***Bug Screen***

3. Add to the, 1st Floor **Room Element,** another Exterior Wall **Element** by following instruction number 1 above under Editing the Exterior Wall Element Click on the new wall to input on the **General** tab:

   Name: ***Back Wall***

   Area: ***320*** ft² (29.7 m²)

   New Assembly: [Assembly Library]: ***R-19 Wall.*** *(*Click on this field to select R-19 Wall from the Library and then click on *OK)*

   Orientation: [drop-down list or user input]: ***South***

   Tilt: ***90*** degrees

4. Add a Window and a Door **Element to the** Back Wall **Element** by following the instruction number 3 above under Editing the Exterior Wall Element. Click on the new Door **element** to input:

   Name: ***Back Door***

   Area: ***16.7*** ft² (1.6 m²)

   Surface Type: ***New***

   New Assembly: [drop-down list]: ***Wood Door***

5. In the Window **element**, input:

   Name: ***Back Windows***

   Area: ***72*** ft² (6.7 m²)

   New Fenestration [Fenestration Library]: ***Anderson Permashield*** ***(Click in this field to choose Anderson Permashield, then click on*** **OK)**

   Exterior Shading tab. Leave the Shading Device set to the default selection: ***Bug Screen***

6. Add to the, 1st Floor **Room Element,** another Exterior Wall **Element** by following instruction number 1 above under Editing the Exterior Wall Element. Click on the new wall to input on the **General** tab:

   Name: ***Right Wall***

   Area: ***240*** ft² (22.3 m²)

   Surface Type: ***New***

   New Assembly: [drop-down list]: ***Wood Door***

   Orientation [drop-down list or user input]: ***West***

   Tilt: ***90*** degrees

7. Add to the Right Wall **Element**, a Window **Element** by following the instruction number 3 above under Editing the Exterior Wall Element. Then in the **General** tab**,** input:

   Name: ***Right Windows***

   Area: ***32*** ft² (3.0 m²)

   New Fenestration [Fenestration Library]: ***Anderson Permashield*** ***(Click in this field to choose Anderson Permashield, then click on*** **OK)**

   Exterior Shading tab. Leave the Shading Device set to the default selection: ***Bug Screen***

Editing the Slab Element (Res Sample)

1. Add the next component to the 1st Floor **Room Element**, Slab on Grade. Then Click on the Slab on Grade **Element** floor to input on the **General** tab

   Name: ***Covered Slab***

   Area: **600** ft² (55.7 m²)

   Surface Type: ***New***

   New Assembly: [Assembly Library]: ***Slab on Grade***

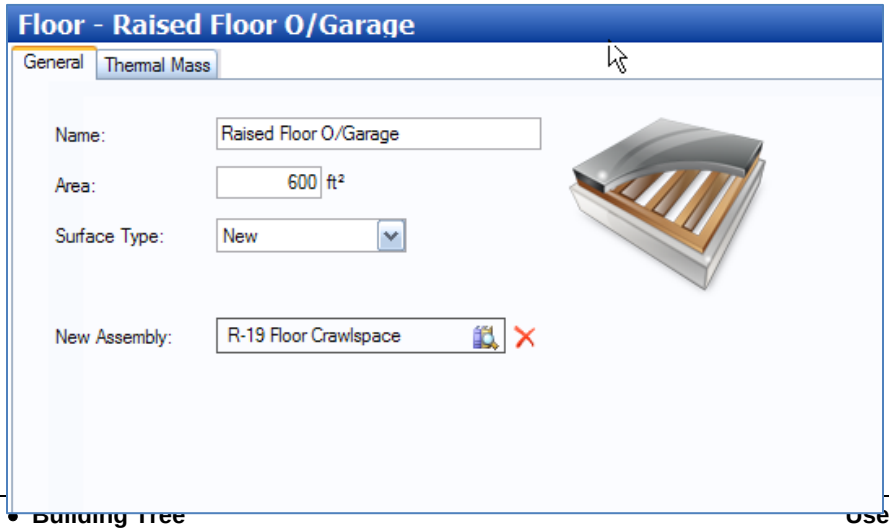
   Ext. Perimeter: ***90*** feet (27.4 meters)

2. Click on the **Thermal Mass** Tab

   Leave all inputs at their default value

   Exposed: Do not check this box as the slab in this example is carpeted.

Editing the Floor Element (Res Sample)



1. Add the next component to the 1st Floor Room Element, Raised Floor. Click on the Raised Floor **Element** to input on the **General** tab:

   Name: ***Raised Flr ovr Garage***

   Area: ***600*** ft² (55.7 m²)

   Surface Type: *New*

   New Assembly: [Assembly Library]: ***R-19 Floor No Crawlspace*** ***(Click in this field to choose R-19 Floor No Crawlspace, then click on*** **OK)**

You have completed practice data input for the 1st Floor Zone.

Continue working your way through the 2nd Floor Zone, viewing the input.

Now that the Building Tree is complete, **Save** the file and run calculations.

Running Calculations (Res Sample)

Initiate calculations from the Calculations list in the lower-left window pane. Once you select which calculations to run for a particular project, you can use the Calculate button on the toolbar. The first time you run calculations for any file, you must set the calculation Options. Once Options are set, click on the Calculate button to initiate Calculations in one step.

1. Select Calculations from the choices in the lower-left window pane. Please Note: You may only run the types of calculations you have purchased. Select User Information from the Help menu to verify the status for each module.
2. Select (check the checkbox) the Res T24 Performance calculation.

The applicable boxes have been checked: Run Standard, Run Proposed, and include Domestic Hot Water in the scope. In addition, we have instructed EnergyPro to delete all temporary files once the simulation is complete.

NOTE: If you have not purchased the Res T24 Performance module, you will not able to run the Res T24 Performance calculation.

3. Select the **Loads** calculation. Leave the inputs set at their default values for this calculation.
4. Now you are ready to run Calculations. Select the Calculate button on the toolbar.
6. **EnergyPro** displays results for each type of calculation you have selected in a tabbed format in the bottom-right window pane.

The Residential Sample Building complies with the *Standards* as shown in the Res T24 Performance Results tab. In addition, the HERS tab lists each of the five HERS measures that require field verification by a certified HERS Rater.

Preparing and Printing Reports (Res Sample)

1. You may either use the Report Wizard to prepare a report for printing or select Reports from the choices in the bottom-right window pane. Select **File/Report Wizard…** from the Main Menu or click on the Report Wizard icon in the toolbar. A wizard welcomes you to the Select Report Type dialog box.
2. Select California Code (Title 24) Performance from the list of Residential reports and and Next to continue.
3. Select the Forms you wish to include in your report by checking (clicking on) the appropriate boxes, then select Next. Note those that have been selected for this sample.
4. To end: In the last box, Report Complete, click Finish to close the Wizard without viewing the report, or the Print Preview button to view your report. It is ready to print, unless you choose to make changes after viewing the Report. You can page up or down through the Title 24 Report that has been prepared for this sample building.

Special Topics

This section presents special issues with which you should be familiar with respect to Title 24 Standards as well as the other calculation modules. The information here may be useful when using EnergyPro for compliance with Title 24 or other standards, such as ASHRAE 90.1, or to produce HERS II ratings, GreenPoint Rated or LEED Title 24 calculations. This chapter covers the following topics:

Residential Compliance Modeling Topics. How to properly zone and model residential buildings for compliance and HVAC equipment selection. Topics include zoning, zonal controls, no setback thermostats, underground walls and floors, heating/cooling distribution systems, hydronic systems, no cooling installed, HERS compliance credits, calculating all four orientations and attached sunspaces, garages and others.

Nonresidential Compliance Modeling Topics. How to properly zone and model nonresidential buildings for compliance and HVAC equipment selection. Topics include partial permit applications, inputting zones by thermal characteristics and occupancy type, standard HVAC system according to proposed system type, modeling like HVAC systems together, unconditioned spaces, demising partitions, interior partitions between zones, underground walls and floors, return air plenums, T-bar ceilings, process loads, tailored and process ventilation, exhaust fans, tailored lighting allotment, and inputs not used for compliance calculations.

Mandatory Measures. How mandatory measures relate to the compliance calculations that the program performs.

Additions. How to use the program to show Title 24 compliance of additions alone or with the existing building.

Mixed Occupancy Buildings. How the Title 24 *Standards* and the program treat mixed occupancy buildings.

Mechanical Systems. An overview on how to model mechanical systems using EnergyPro, including case studies.

Default DOE-2.1E Output Reports in the Nonresidential Performance (.SIM) File. A list of the DOE-2.1E calculation output reports generated when you clear the Delete Temporary Files after Simulation is Complete checkbox in the NR Performance Calculation Options tab.

California Advanced Homes. An energy efficiency incentive program available to residential new construction projects in many parts of CA.

Residential Title 24 Compliance Modeling Topics

The zoning of residential buildings for the HVAC system(s), for calculating design loads, and for calculating energy compliance is a complex topic. There are basic principles and guidelines which you should consider in deciding how a building is modeled. This section presents guidelines and special techniques which may assist you in modeling residential buildings. Topics include:

Dividing the Building into Zones and Systems

Zonal Controls

No Setback Thermostats

Underground Walls and Floors

Heating and Cooling Distribution Systems

Hydronic Systems

No Cooling Installed

Calculating All Four Orientations

Attached Sunspaces and Garages

Thermal Mass

HERS Compliance CreditsHERS Registration

Attic Radiant Barriers

Cool Roofs

Pool and Spa Equipment

Dividing the Building Into Zones and Systems

A basic and important question that must be considered before taking the areas of walls, windows, roofs and floors off the plans, is:

How is the building zoned?

NOTE: You will use both the Zone and Room elements to enter data for what is described here as a "residential zone". You will use the Zone element simply to name the zone and set the floor number; you will use the Room element within that zone to describe that zone's envelope features (types of walls, floors, glazing, etc.). In practice, the Room element will usually cover a number of rooms, or possibly an entire floor.

In designing the HVAC zoning of a residential building, a few primary issues come up:

- ☐ As a general rule, use the minimum number of Zones and Systems to produce the information needed for both compliance and equipment selection. Can comfort throughout the building be maintained with a single thermostat? If not, how must the building be divided up to maintain comfort?
- ☐ What type of mechanical system will be installed? A standard split system forced air furnace and air conditioner with no special duct damper controls can serve only a single thermostat zone. Two such systems can serve two separate zones. A radiant hydronic space heating or variable refrigerant flow cooling system can serve many different thermostatically controlled zones.
- ☐ Standard residential air conditioning equipment goes up to only a nominal 5-ton cooling capacity (up to approximately 45,000 Btuh sensible capacity under typical design conditions). If the building has larger cooling loads, additional condensing units might be needed to meet the load.
- ☐ Because EnergyPro allows you to calculate design heating and cooling loads by system and room, you can use the program in various ways. For example, you may not be sure whether a certain piece of equipment can meet the entire house cooling load. In this case you may choose to input the house description as several zones. If the equipment cannot meet the entire load, simply drag one (or more) of the zones to a new system.
- ☐ Since zonal control credit is available within the residential compliance calculations (see Zonal Control in the Glossary of the Joint Appendices, JA1), you may wish to divide a residential building into a Living Zone and a Sleeping Zone, consistent with the minimum zonal control credit requirements.
- ☐ The program adds up all the attributes of all Zones and Systems within the building when it performs the compliance calculations. Although HVAC system efficiencies are area-weighted by System, zoning is primarily a design issue, not a compliance issue.
- ☐ If it is clear from the outset that, for example, there is no mechanical cooling and/or the whole house will operate on a single thermostat, you may then treat the house effectively as a single Zone. Set the Floor Number to the number of habitable stories in the building although the Zone includes the attributes of all floors, roofs, walls, etc.

☐ If air conditioning will be installed or is optional, the sensible cooling loads and air flow requirements are likely to dictate how the house is zoned. In this case it might be a good idea to break the building description into several Zones. By performing load calculations, you may be able to aggregate Zones and evaluate which piece or pieces of HVAC equipment are suited to serve each Zone.

☐ When two or more different pieces of equipment are to be used, separate Systems with separate Zones will properly model the performance of the Systems for both compliance and design purposes.

Zonal Controls

To take credit for zonal controls in a residential building,

Create separate zones for the living and sleeping portions of the house. Each zone must have its own thermostat, and the non-closeable opening between the zones can be no greater than 40 square feet. In the Residential Tab of the System Element, select either Living or Sleeping for the Thermostat as appropriate. Set the zone which includes the living spaces of the house (i.e., living room, kitchen, dining room) to *Living*. Set the zone which includes the sleeping spaces in the house (i.e., bedrooms) to *Sleeping*. Additionally, you must model the interior surfaces and open areas between the Living and Sleeping zones. Refer to Chapter 4.5.2 of the *Residential Manual* for more details regarding zonal control special modeling techniques.

Excerpts from the guidelines in the *Residential Manual* and *Residential ACM* for modeling zonal controls follows.

Residential Manual, Chapter 4.5.2:

There are unique eligibility and installation requirements for zonal control to qualify under the Standards. The following steps must be taken for the building to show compliance with the Standards under this exceptional method:

1. **Temperature Sensors**. Each thermal zone, including a living zone and a sleeping zone, must have individual air temperature sensors that provide accurate temperature readings of the typical condition in that zone.
2. **Habitable Rooms**. Each habitable room in each zone must have a source of space heating and/or cooling (if zonal credit for cooling is desired) such as forced air supply registers or individual conditioning units. Bathrooms, laundry, halls and/or dressing rooms are not habitable rooms.
3. **Non-closeable Openings**. The total non-closeable opening area (W) between adjacent living and sleeping thermal zones (i.e., halls, stairwells, and other openings) must be less than or equal to 40 ft². All remaining zonal boundary areas must be separated by permanent floor-to-ceiling walls and/or fully solid, operable doors capable of restricting free air movement when in the closed position.
4. **Thermostats**. Each zone must be controlled by a central automatic dual setback thermostat that can control the conditioning equipment and maintain preset temperatures for varying time periods in each zone independent of the other.

Other requirements specific to forced air ducted systems include the following:

1. Each zone must be served by a return air register located entirely within the zone. Return air dampers are not required.
2. Supply air dampers must be manufactured and installed so that when they are closed, there is no measurable airflow at the registers.
3. The system must be designed to operate within the equipment manufacturer's specifications.
4. Air is to positively flow into, through, and out of a zone only when the zone is being conditioned. No measurable amount of supply air is to be discharged into unconditioned or unoccupied space in order to maintain proper airflow in the system.

Although multiple thermally distinct living and/or sleeping zones may exist in a residence, the correct way to model zonal control for credit requires only two zones: one living zone and one sleeping zone. All

separate living zone components must be modeled as one single living zone; the same must be done for sleeping zones.

Residential ACM, Chapter 5.9:

To use this compliance credit the measured air flow in CFM and the fan watt requirements defined in the Reference Residential Appendix RA3.3 must be met. The total non-closable opening area between zones cannot exceed 40 ft^2. Other eligibility criteria for this measure are presented in the Reference Residential Appendix RA4. Internal gains in the living zone shall be 20,000 Btu/day plus 15 Btu/ft^2. Internal gains in the sleeping zone shall be 15 Btu/ft^2.

No Setback Thermostats

Setback thermostats are a mandatory measure for most HVAC systems as explained in Section 4.5.1 of the *Residential Manual and* the Standards, Section 112(c). Title 24 allows certain systems to be installed without setback thermostats if the energy penalty is modeled with a computer performance method such as Residential T24 Performance.

The systems which may be modeled in EnergyPro's Residential T24 Performance module with No Setback Thermostats are:

- ☐ Non-central electric heaters
- ☐ Room air conditioners
- ☐ Room air conditioner heat pumps
- ☐ Gravity gas wall heaters
- ☐ Gravity floor heaters
- ☐ Gravity room heaters
- ☐ Wood Stoves
- ☐ Fireplace or decorative gas appliances

To model one of these systems with no setback thermostat, open the System element and select the Residential Tab. Select No Setback from the available thermostat choices, and run Res T24 Performance to see if the building complies.

Underground Walls and Floors (Residential)

Underground Walls

For low-rise residential construction, use the Underground Wall element to model basement or other walls below grade. Residential compliance calculations divide underground walls into three separate categories depending on the depth below grade; shallow (up to two feet below grade), medium (two to six feet below grade), and deep (greater than six feet below grade) walls. Create a separate underground wall construction assembly for each category, and set the exterior absorptivity to 0.0; there is no radiant gain from sunlight. Input the depth below grade in inches (mm) for each underground wall assembly type. Refer to Section 3.5.3 of the Residential ACM Manual for additional details.

Underground Floors

Use the Underground Floor element to model basement (below grade) floors. Model the construction assembly as it exists.

Heating and Cooling Distribution Systems

If there are any ducts in unconditioned space, you must specify the distribution system location. Ducts in Attic is the default location, with no associated credits or penalties. Many distribution system features require field

verification by an approved HERS rater. Refer to the HERS Compliance Credits topics for additional details regarding those measures.

- ☐ You may select Crawlspace or Basement for ducts located in a crawl space or basement if the duct layout and design are shown on the plans and if all supply registers are located in the floor (or no more than two feet above the floor). If any building story has supply registers located more than two feet above the floor, you must select the Attic for that entire floor.
- ☐ If all ducts are 100% within the conditioned envelope, select Ducts in Conditioned.
- ☐ If the system has fan coils with no ducts, select Ductless with Fans.
- ☐ For a gas wall furnace without fans, select Ductless for the Heating and Cooling Distribution.
- ☐ With a hydronic radiant floor system, select Radiant Floor.
- ☐ With hydronic baseboard or electric baseboard, select Baseboard.
- ☐ If ducts are in a slab-on-grade or slab-below-grade, select Ducts in Attic with a duct R-value of 4.2.
- ☐ For hydronic piping, see Hydronic Systems.
- ☐ Ducts buried under insulation, with reduced leakage, or reduced surface area must be verified by an approved HERS rater.
- ☐ If there is no cooling installed, see the No Cooling topic for modeling details.

Hydronic Systems

Residential Systems

Residential hydronic heating systems are typically either dedicated (providing only space heating), or combined (providing both space and water heating). Refer to Sections 4.7.1 and 4.7.2 in the Residential Manual for additional details regarding hydronic heating systems.

Combined hydronic space and water heating systems are modeled as follows:

In the Plant element, under the Domestic Hot Water tab, create a DHW System with a water heater or boiler selected from the DHW Library. Include all the standard water heating system attributes, including features of the distribution system. In the Combined Hydronic Piping section of the tab, enter the length of pipe associated with the hydronic system which is in unconditioned space, the pipe diameter, and the insulation thickness on that pipe.

Create a *New* Split FAU-A/C system in the Central System library and assign it a name. Set the Heating Tab entries to zero, and all other Central System entries to the actual conditions. EnergyPro automatically calculates the effective efficiency (AFUE or HSPF) from the water heater characteristics and pipe losses. Save the entry in the library and select that system in the General Tab of the System Element to properly document the hydronic system. In the Distribution Tab, select the heating distribution type from the drop-down list based upon the actual condition. This could be Radiant Floor if the piping is embedded in the floor, Baseboard if the system uses perimeter hot water radiators, or in some cases a Ducted system if using fan coils. In the Residential Tab, select *DHW Boiler Provides Heat* from the Hydronic Space Heating drop-down list.

Dedicated (separate) hydronic space heating systems are modeled as follows:

In Plant, Heating Hot Water Tab, select a boiler from the Boiler library and input a multiplier. In the Hydronic Heating section of the tab, enter the length of pipe associated with the hydronic system which is in unconditioned space, the pipe diameter, and the thickness of insulation on that pipe. If less than 10 feet of pipe is in unconditioned space, EnergyPro assumes there are no pipe losses.

Create a *New* HVAC system in the Central System library, assign it a name, and enter the output of the hydronic system. Enter all other Central System entries to the actual conditions. EnergyPro automatically calculates the effective efficiency (AFUE or HSPF) from the boiler characteristics and pipe losses. Save the entry in the library and select that system in the General Tab of the System Element to properly document the

hydronic system. In the Distribution Tab, select the heating distribution type from the drop-down list based upon the actual condition. This could be Radiant Floor if the piping is embedded in the floor, Baseboard if the system uses perimeter hot water radiators, or in some cases a Ducted system if using fan coils. In the Residential Tab, select *Heating Boiler Provides Heat* from the Hydronic Space Heating drop-down list.

If the hydronic heating only serves a portion of the residence, you must model the hydronically-heated area under its own Plant element. If the area is also served by its own water heater, then complete the applicable data in the DHW tab also. If there is no separate water heater in this area for domestic consumption (i.e. the entire house is served by a single water heater) leave the DHW system tab(s) "Undefined". Alternatively, use a DHW multiplier of zero. You might also enter a comment in the Remarks box in the Building element noting that the hydronic area receives domestic hot water from a water heater modeled under another Plant element.

Nonresidential Systems

Combined hydronic space and water heating systems are modeled as follows:

In the Plant element, under the Heating Hot Water Tab, create a boiler or select one from the Boiler Library. Enter the Boiler pump capacity and energy use data. Do not model a domestic hot water system; the program automatically calculates the service water heating load on the boiler. In the System element, create either a Four-Pipe Fan Coil (FPFC) if design does not call for economizers, Built-Up Single Zone (BUSZ) if the design calls for economizers, or in a heating hot water only situation; a Split DX HVAC system.

The hydronic system may also have a chilled water cooling component, in which case, also model the chiller and cooling tower (Four-Pipe Fan Coil and Built-up systems only).

No Cooling Installed

When no mechanical cooling equipment is installed, even if cooling can be added as optional, use the following modeling procedure:

In HVAC System, select a central system which has the desired heating output and a cooling output capacity of zero (0) Btuh. EnergyPro automatically sets the efficiency equal to the standard design; there is no compliance credit or penalty. (You may wish to create a system in the Central System Library and name the cooling system “No Cooling”.)

Save the entry in the library and select that system in the General Tab of the System Element to properly document the system. In the Distribution tab, if the heating system is ducted, assign the heating and cooling ducts the same location and insulation level. If the heating system is not ducted, set the cooling duct insulation to the prescriptive (Package D) value for that climate zone, and the duct location to Ducts in Ventilated Attic.

Calculating All Four Orientations

You may show compliance for a home plan so that it may be built in any orientation (as explained in the Residential Manual, Section 7.6 on Subdivisions and Master Plans), by calculating compliance of the unit in all four orientations. To do this within the program:

Input the unit plan, set the Front Orientation to due north and the Rotation to zero.

When you run Res T24 Performance, check the Run Four Orientations box in the Options tab of the Calculations. EnergyPro will run compliance calculations for the building in all four cardinal orientations.

After the calculation is complete, the results are displayed in the Results pane in the bottom-right section of the window. EnergyPro lists the Standard Building results first, followed by results for each of the four cardinal orientations.

If the unit does not comply initially in all four orientations, choose the orientation with the worst results (i.e., where the building fails by the greatest margin). Make changes to the building and recalculate until the unit complies in all four orientations.

EnergyPro prints the detailed simulation results for each orientation on Part 3 of the CF-1R form and also notes that you selected compliance for all orientations in the Special Features section in Part 2.

Multifamily Buildings: You may also use this feature to document compliance of individual dwelling units in multifamily buildings. Refer to Section 7.5 of the Residential Manual for additional details.

NOTE: Do not select Four Orientations if you are performing an Existing-plus-Addition calculation as explained in Additions.

Attached Sunspaces and Garages

Most often, sunspaces and attached garages are unconditioned spaces and are not required to be modeled in residential compliance calculations. You must model all the surfaces that separate conditioned and unconditioned space, including fenestration areas, and doors. In addition, sunspaces must comply with the residential lighting requirements in Section 150 of the Standards.

A sunspace may possibly be an indirectly conditioned space and not an unconditioned space, according to the definition in the *Standards*. If a space is indirectly conditioned, you must include the floor area as part of the conditioned floor area, and include all the exterior surfaces as part of modeling the building.

Thermal Mass

The software assumes certain thermal mass characteristics for most low-rise residential projects which are modeled identically in both the proposed and standard designs. If your project contains enough thermal mass to exceed a "high" mass threshold, you may claim compliance credit for the additional thermal mass.

The software assumes that all residential projects contain a pre-set amount of "light" thermal mass; framing, furniture, appliances, etc. Light thermal mass is always modeled identically in both the proposed and standard designs. "Heavy" mass is modeled identically up to a pre-determined amount (the mass threshold), based upon the conditioned area of slab floor and non-slab floor. If the thermal mass in the proposed design does not exceed the mass threshold, then both the standard and proposed designs are assumed to contain 20% of the proposed design's conditioned slab floor area as exposed slab, 80% of the conditioned slab floor area as rug-covered slab, and 5% of the proposed design's conditioned non-slab floor area as exposed 2 inch thick concrete.

If the proposed design contains more thermal mass than the mass threshold, model the mass for compliance credit. The mass threshold is determined by the amount of mass equivalent to 30% of the conditioned slab floor area as exposed 3.5 inch thick concrete slab, 70% of the conditioned slab floor area as rug-covered 3.5 inch thick concrete slab AND 15% of the conditioned raised floor (non-slab) area as 2 inch thick exposed concrete.

Refer to thermal mass in Section JA4 and RA5 of the Reference Appendices and Section 3.4 of the Residential Manual for additional information on modeling thermal mass.

HERS Compliance Credits

Title 24 requirements allow modeling certain energy efficiency improvements in low-rise residential projects which require field verification and diagnostic testing. Compliance credits are available for measures that improve the efficiency of heating and cooling equipment and distribution systems (ducts), and for constructing buildings with less leakage than results from standard construction practices. Most of these compliance credits require diagnostic testing and field verification by a certified HERS rater. Diagnostic testing and field

verification protocol and requirements are described in detail in Sections RA2 and RA3 of the Reference Residential Appendices.

Compliance credit cannot be taken for any duct efficiency improvement unless the duct system is a fully ducted system. Duct efficiency credits may not be taken for any system that uses building cavities such as plenums or platform returns. Also, when any duct efficiency credit is claimed, the duct connections and leaks shall not be sealed with cloth back rubber adhesive tapes (i.e., duct tapes) unless such tape is used in combination with mastic and drawbands.

Measures that require field verification and/or diagnostic testing follow:

Reduced Duct Leakage: Prescriptive packages for all climate zones require that the leakage rate for new duct systems be less than 6 percent of the supply airflow. Thus, the standard design assumes all new duct systems have been sealed and tested. Reducing duct leakage also results in a compliance credit for reducing the overall building leakage if credit is not taken separately for reduced building leakage.

Diagnostic Supply Duct Location, Surface Area and R-Value: Allows the designer to take credit for a high efficiency duct design that incorporates duct system features that do not meet the criteria for the duct location and/or insulation compliance options alone. This method requires that the designer must enter the design characteristics of all supply ducts that are not located within conditioned space. This compliance option also allows credit for the special case of ducts that are buried by blown attic insulation.

Duct Location: There are three ways to achieve credit for favorable duct location when using the performance compliance method.

- If no more than 12 LF (linear feet) of supply duct are outside conditioned space
- When 100 percent of the supply ducts are located in either the crawlspace or the basement rather than in the attic, and if the design specifies that all supply registers are located in the floor or within two feet of the floor, and shows the appropriate locations for the ducts. This measure requires field verification by the inspector, and does not require HERS Rater verification.
- High efficiency duct design credit through the Diagnostic Supply Duct Location, Surface Area, and R-value compliance option described above.

Duct Insulation (Buried and Deeply Buried Ducts): Ducts that are buried by attic blown in insulation may be eligible for a compliance credit if they meet all requirements. Ducts lying on the ceiling or within 3.5 inches of it are considered buried ducts, and deeply buried ducts are enclosed in a lowered section of the ceiling and completely covered by the insulation. Credit for buried ducts requires that the the system must meet the verified duct design criteria, be diagnostically tested for duct sealing compliance, according to Reference Residential Appendix RA3.1, and meet the requirements for high insulation installation quality described in Reference Residential Appendix RA3.5. In addition, verified prescriptive cooling coil airflow is required when a measure is selected for compliance that has a verified duct design as a prerequisite.

Performance credit is also available if all ducts are insulated to a level higher than required by the prescriptive packages, but higher insulation values alone does not require HERS verification, as described below.

Low Leakage Ducts in Conditioned Space: Defined as duct systems for which air leakage to outside conditions is equal to or less than 25 cfm when measured in accordance with Reference Residential Appendix RA3.1.4.3.9.

Low Leakage Air Handlers: Factory sealed air handler unit tested by the manufacturer and certified to the Commission to have achieved a 2 percent or less leakage rate at 1-inch water gage, as prescribed in Reference Residential Appendix RA3.1.4.3.10.

Refrigerant Charge in Split System Air Conditioners and Heat Pumps: Systems are often installed without the proper refrigerant charge, which degrades the air conditioner performance. A compliance credit is available if the split system air conditioner or heat pump has diagnostically tested refrigerant charge. This credit applies only to split system air conditioners and heat pumps; it does not apply to package equipment. In CZ 2, and 8-15, refrigerant charge measurement is a prescriptive requirement.

Refrigerant Charge Indicator Display (CID): The purpose of the CID is to provide real-time information to the building occupant about the status of the system refrigerant charge, metering device, and cooling coil airflow. Refer to Reference Appendix JA6 for additional details on the requirements for charge indicator displays.

Verified Cooling Coil Airflow: Prescriptively, in Climate Zones 10-15 the central forced air system fans must maintain airflow greater than 350 CFM per nominal ton of cooling capacity across the cooling coil and have a fan watt draw less than 0.58 Watts/CFM. Adequate cooling coil airflow rates must be attained in order to deliver maximum rated capacity and efficiency. Refer to Section 4.3.3 of the Residential Manual and Reference Appendix RA3.3 for additional details.

Air Handler Fan Watt Draw: Credit is available for demonstrating that a high efficiency fan and duct system with a low wattage fan has been installed. Reducing the central forced air system fan Watt draw can provide significant peak demand savings because the fan is generally running continuously on the hottest days when the electricity system peaks occur. All prescriptive packages require central forced air systems to install a fan that draws less than 0.58 Watts/CFM. Performance compliance credit is available for demonstrating the installation of a high efficiency fan and duct system with a lower wattage fan than the prescriptive requirement. Refer to Section 4.3.3 of the Residential Manual and Reference Appendix RA3.3 for additional details.

High Energy Efficiency Ratio (EER): The EER is the full load efficiency at specific operating conditions. It is possible that two units with the same SEER can have different EERs. Using the performance compliance method, credit is available for specifying an air conditioner with an EER greater than 10. Presence of a matched High Efficiency Compressor Unit, Evaporator Coil, Refrigerant Metering Device, and (where specified) Air Handling Unit and/or Time Delay Relay Maximum Rated Cooling Capacity: Avoiding oversizing is especially important for cooling equipment because efficiency degrades when the system cycles on and off frequently. Refer to Section 4.3.3 of the Residential Manual and Reference Appendix RA3.4 for additional details.

Maximum Rated Total Cooling Capacity: Title 24 offers a compliance credit when the installed air conditioning equipment is sized in accordance with the Reference Residential Appendix RA1.4. The calculations for determining Maximum Rated Total Cooling Capacity need not be field verified, but the prerequisites to taking the credit – Prescriptive Cooling Coil Airflow, duct sealing, and EER – must be field verified and diagnostically tested.

Evaporatively Cooled Condensers: Evaporatively cooled condensers work by replacing the outdoor unit of a standard air cooled air conditioner. When credit for an evaporatively cooled condenser is taken, the project must also include sealed ducts and proper refrigerant charge and airflow or a charge indicator lights.

Ice Storage Air Conditioners: Ice storage air conditioners run the compressor during the off-peak hours (nighttime) to create ice and store it for cooling the following day. When cooling is required, the system uses the ice in the storage tank rather than the compressor to provide cooling. When credit for an ice storage air conditioner is taken, the project must also include sealed ducts and proper refrigerant charge and airflow or a charge indicator lights. You may only claim compliance credit for an ice storage system using the performance method.

Building Envelope Sealing (or Blower Door Testing): You may claim credit for reducing the building envelope leakage below the standard Specific Leakage Area (SLA) for an untested home of 4.3 ft² of leakage area per 10,000 ft² of floor area. Check the Building Leakage Test checkbox and enter the SLA target in the HERS Credits tab of the System Element. Refer to Section 3.5.3 of the Residential Manual for additional details. The CEC considers dwellings with target or measured SLA values of 1.5 or less to be “unusually tight construction” per the California Mechanical Code, and requires that such dwellings must meet specific ventilation criteria. “Unusually tight” building envelope construction requires mechanical ventilation that will not cause dangerous pressure imbalances. Refer to Section 4.6 of the Residential Manual for additional details regarding indoor air quality and ventilation requirements.

High Quality Insulation Installation (QII): EnergyPro automatically degrades the assumed performance of wall and ceiling insulation to account for common flaws in the insulation installation. Compliance credit is available for improving the quality of the insulation by eliminating gaps and compressions, and ensuring

the insulation is in contact with the interior air barrier. Refer to Section 3.3.7 of the Residential Manual and Reference Appendix RA3.5 for additional details.

Quality Insulation Installation for Spray Polyurethane Foam (SPF): There are two types of SPF insulation; medium density, or closed cell, and low density, or open cell insulation. Low density SPF open cell insulation has an R-value of 3.6 per inch, and medium density, closed cell SPF has been assigned an R-value of 5.8 per inch for compliance purposes. You may claim compliance credit for installation of medium density closed cell spray polyurethane foam. Medium density is not required to fill the cavity. The nominal thickness of the SPF insulation shall be such that (1) the average thickness shall be equal to or greater than that required to meet the design R-value of the assembly, and (2) the minimum tested thickness shall be no more than ½ inch less than the required thickness for the R-value. Refer to Section 3.3.7 of the Residential Manual and Reference Joint Appendix JA7 for additional details regarding the required installation procedures and eligibility for credit.

PV Field Verification Protocol: To receive a New Solar Home Partnership rebate, the output of the installed photovoltaic system must be field verified to show compliance with the information on the application to receive a New Solar Home Partnership rebate. See Reference Appendix RA3.6 for additional details regarding the field verification requirements.

Some measures require only field verification by the building inspector, but because they can provide significant compliance credit, they are listed in the Special Features Inspection Checklist on the CF-1R Form to alert the inspector of the measure's presence.

Duct efficiency improvements and building envelope air sealing measures that are considered Special Features, but do not require HERS verification include:

Duct insulation: Performance credit is available if all ducts are insulated to a level higher than required by the prescriptive packages. If ducts with multiple R-values are installed, the lowest duct R-value shall be used for the entire duct system. Alternatively, when there's a mix of duct insulation values, you may use the Supply Duct Location, Surface Area and R-Values credit described above. However, the air handler, plenum, connectors, and boots can be insulated to the mandatory minimum R-value.

Ducts in Attics with Radiant Barriers: Installation of a radiant barrier in the attic increases the duct efficiency by lowering attic summer temperatures. Compliance credit for radiant barriers requires listing of the radiant barrier in the Special Features and Modeling Assumptions listings to aid the local enforcement agency's inspections.

Supply Duct Location: When 100 percent of the supply ducts are located in either the crawlspace or the basement rather than in the attic, and if the design specifies that all supply registers are located in the floor or within two feet of the floor, and shows the appropriate locations for the ducts. A duct layout must be included in the plans that show that all of the supply registers are located in the floor (or no more than two feet above the floor).

Building envelope air sealing associated with duct sealing (default compliance credit): If compliance credit is not taken for reduced building envelope air leakage through diagnostic testing (as described in detail below), a special "default" compliance credit can be taken for building envelope leakage reduction. To qualify for this credit all requirements for reduced duct leakage, including diagnostic testing, must be met. A "default" reduction in Specific Leakage Area (SLA) of 0.50 is allowed for this credit. This adjustment reduces the standard SLA from 4.3 to 3.8.

Building envelope air sealing associated with air retarding wrap installation (default compliance credit): If compliance credit is not taken for reduced building envelope air leakage through diagnostic testing, a special "default" compliance credit can be taken for building envelope leakage reduction resulting from installation of an air-retarding wrap. Compliance credit is provided for a "default" reduction in SLA of 0.50 for an SLA of 3.8. This credit may be combined with the credit for reduced duct leakage, reducing the SLA by a total of 1.0, from 4.3 to 3.3.

HERS Registration Requirements

The 2008 Title 24 Standards require Title 24 documentation authors to register some residential new construction projects with a HERS Provider. The requirements apply to certain lowrise residential new construction projects that require HERS verification to comply with the Standards.

Initially, beginning January 1, 2010, the registration requirement applies only to those homes that include HERS measures and that document compliance using the multiple orientation alternative. As of October 1, 2010, all new lowrise residential projects (that require HERS verification for compliance) are required to complete the registration process.

Attic Radiant Barriers

Prescriptive requirements specify a radiant barrier in Climate Zones 2, 4 and 8 through 15, those zones with high cooling loads. Radiant barriers are most effective during the cooling season, reducing the summer attic temperature, thus increasing duct efficiency. In the performance approach, radiant barriers are modeled as separate adjustments to the heating U-factor and the cooling U-factor. If you specify a radiant barrier, it will be listed in the Special Features and Modeling Assumptions section of Form CF-1R.

Radiant barriers must meet specific eligibility and installation criteria to be modeled by any ACM and receive compliance credit for low-rise residential buildings. The following is an excerpt from the Reference Residential Appendices, RA4.2.2. Also refer to Section 3.3.3 of the Residential Manual for additional details.

The emissivity of the radiant barrier must be less than or equal to 0.05 as tested in accordance with ASTM Test Method C-1371 or ASTM E408.

Installation shall conform to ASTM C1158 (Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Building Construction), ASTM C727 (Standard Practice for Installation and Use of Reflective Insulation in Building Constructions), ASTM C1313 (Standard Specification for Sheet Radiant Barriers for Building Construction Applications), and ASTM C1224 (Standard Specification for Reflective Insulation for Building Applications), and the radiant barrier shall be securely installed in a permanent manner with the shiny side facing down toward the interior of the building (ceiling or attic floor). Moreover, radiant barriers shall be installed at the top chords of the roof truss/rafters in any of the following methods:

i. Draped over the truss/rafter (the top chords) before the upper roof decking is installed.

ii. Spanning between the truss/rafters (top chords) and secured (stapled) to each side.

iii. Secured (stapled) to the bottom surface of the truss/rafter (top chord). A minimum air space shall be maintained between the top surface of the radiant barrier and roof decking of not less than 1.5 inches at the center of the truss/rafter span.

iv. Attached [laminated] directly to the underside of the roof decking. The radiant barrier shall be laminated and perforated by the manufacturer to allow moisture/vapor transfer through the roof deck.

In addition, the radiant barrier shall be installed to cover all gable end walls and other vertical surfaces in the attic.

The attic shall be ventilated to:

i. Conform to the radiant barrier manufacturer's instructions.

ii. Provide a minimum free ventilation area of not less than one square foot of vent area for each 150 square feet of attic floor area.

iii. Provide no less than 30 percent of the vents located high in the attic (within two feet of the highest point in the attic).

Ridge vents or gable end vents are recommended to achieve the best performance. The material should be cut to allow for full air flow to the venting.

The product must meet all requirements for California certified insulation materials [radiant barriers] of the Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation as specified by CCR, Title 24, Part 12, Chapter 12-13, Standards for Insulating Material.

Cool Roofs

A “Cool Roof” is a roofing material with high solar reflectance and high emittance that reduces heat gain through the roof. Compliance credit may be taken when a cool roof is installed when using the performance approach. The credit is available only if there is no radiant barrier installed. In the performance method calculations, the cooling benefit of a cool roof is assumed to be equal to that of a radiant barrier. There is no heating impact calculated for a cool roof (while there is some heating benefit assumed for a radiant barrier).

To model a Cool Roof, from the Roof element of the Building Tree, click on the Assembly field to open the Assembly Library and edit the cool roof-related fields. These include the checking the CRRC certified checkbox, selecting the roofing type from the drop-down list, and entering the CRRC-certified Aged Solar Reflectance and Thermal Emittance values. If the certified Aged Solar Reflectance isn’t available, use the equation in Section 3.7.1 of the Residential Manual to calculate it.

Refer to Section 3.7.1. of the Residential Manual for additional information about the mandatory requirements for residential roofing products and Section 3.7.2 for prescriptive requirements, which vary depending on the climate zone and roofing material. Also refer to Section 3.4 in the Nonresidential Manual for details regarding nonresidential requirements.

Pool and Spa Equipment

Sections 114 and 115 of the Standards describe the mandatory requirements for pool and spa heating equipment. All requirements are mandatory and cannot be used for achieving compliance using the performance path. The Standards include manufacturer’s as well as installation requirements, including a minimum thermal efficiency, switching, operation instructions and other features, as detailed in the Standards and Section 5.2.9 of the Residential Manual.

Nonresidential Compliance Modeling Topics

The state’s *ACM Approval Manual* (Nonresidential) requires that program documentation "…contain a chapter or section on how to model buildings for compliance and how to prepare a building input file for a compliance run". This section is intended to fulfill that purpose and explain other special topics:

Modeling Guidelines for Compliance

Partial Permit Applications

Inputting Zones by Thermal Characteristics and Occupancy Type

Standard HVAC System According to Proposed System Type

Modeling Like HVAC Systems Together

Unconditioned Zones

Demising Partitions

Hydronic Systems

Underground (Berm) Walls and Floors

Return Air Plenums

Process Loads

Tailored and Process Ventilation

Tailored Lighting Calculations
Daylighting
Exhaust Fans
Nonresidential Fenestration
Cool Roofs
Tight Duct Credits in Nonresidential

Modeling Guidelines for Compliance

How To Prepare A Building Input File For A Compliance Run

There are several key points to consider in preparing a building input file for a compliance run.

First, be sure you are clear what conditioned space is being permitted including both directly, indirectly conditioned, and unconditioned space as defined in the *Standards*. Unconditioned spaces should be modeled as separate zones, as explained in Unconditioned Zones.

Determine whether the permitted space (i.e., the "building" as defined by the *Standards*) is new construction, an addition, an alteration, etc. Indicate the Project Building Type in the Project Design Data tab of the Building element.

Determine which components of the building --envelope, indoor lighting, outdoor lighting, and/or mechanical systems--are to be modeled for compliance. Enter the Designer names or select them from the Contacts Database, for the components to be included, under the appropriate Designer tabs in the Building element. Using a worksheet, prepare a summary of information for the envelope surfaces, Plant, Systems, and Zones which comprise the building.

What Envelope Surfaces To Model

Model all exterior roofs/ceilings, exterior walls, underground walls, exterior floors, slabs-on-grade and slabs-below-grade. Model all exterior windows, skylights and doors. Model interzone surfaces between thermally dissimilar zones (demising partitions), and model surfaces between conditioned and unconditioned zones using the Interior Surface element.

Entering Envelope Surface Data

See the Building Tree for detailed descriptions of all surface data inputs. Also refer to the applicable Special Topics later in this section.

Written Justification For Exceptional Conditions

The program prints a Certificate of Compliance (PERF-1C) form with every performance (NR T24 Performance) report. At the end of the PERF-1C form is a section entitled Exceptional Conditions Compliance Checklist which flags important conservation measures modeled in the calculation of the proposed design energy use.

You must provide appropriate written justification and additional documentation on the plans and in the specifications for each of the items listed under this heading. For example, if Premium Efficiency supply fan motors are claimed as an energy conservation measure, cut sheets and/or other data on the fan motors must be submitted to document the intended installation of the more efficient fan motors.

Appropriate Zoning For Compliance Modeling

Zoning must be determined and input according to several key criteria:

Actual mechanical system zoning, if known; or,

Perimeter and interior zones, where merging thermodynamically similar zones is acceptable; and,

Occupancy types, including different lighting Area Categories and different ventilation requirements.

In general, zones served by different HVAC systems must be modeled separately; perimeter and interior zones must be modeled separately; and subzones which are different occupancy types must be modeled as separate zones. See Inputting Zones By Thermal Characteristics and Occupancy Type.

Selecting Correct Occupancy Types

In order for the program to establish the correct energy budget, each zone in the proposed building must be designated with the correct occupancy type. The occupancy selection must be defensible from the perspective of which prescriptive lighting Area Category most closely matches the lighting requirements of the zone. You must also pay attention to the possibility of special ventilation requirements in such occupancies as automobile repair shops, beauty salons, smoking lounges and theaters.

If you are unsure of which occupancy type to select, choose one with a prescriptive lighting allotment that is appropriate for the lighting task specified or implied. Refer to Inputting Zones By Thermal Characteristics and Occupancy Type.

How Fixed And Restricted ACM Inputs Work

When used for Title 24 compliance, the program automatically fixes or restricts certain inputs. For example, the nonresidential performance approach automatically uses fixed daily schedules for lights, equipment, people, etc., regardless of the actual schedules you have selected from the Schedule Library. For another example, the absorptivity of assemblies is restricted to between 0.20 and 0.90 even if a value outside that range is entered. All fixed and restricted inputs are described in the ACM Approval Manual (Nonresidential).

Program Modeling Limitations

The program has modeling limitations when it is used as a compliance performance approach. Some of these limitations include:

Maximum # of Systems	256
Maximum # of Zones	1024
Maximum # of Rooms	1024
Maximum # of Exterior Walls	4096
Maximum # of Underground Walls	256
Maximum # of Doors	1024
Maximum # of Windows	8192

One type of cooling tower and boiler per plant, and one type of HVAC equipment per system (although you may model multiple pieces of equipment of the exact same type and size).

Nonresidential Manual

The CEC Nonresidential Manual is required reading, and must be accessible while using the program in order to maintain a current license agreement with EnergySoft and receive user support.

Partial Permit Applications

The general rule when using the performance method is that you may model a specific building component or system for compliance (i.e., envelope, lighting, and mechanical) only if that component or system is designed for and covered by the current permit application.

In alterations, partial permits are quite common. If the lighting system is not being altered, the existing lighting need not meet the Standards. If the envelope is not being changed, the envelope need not meet the *Standards*. If a mechanical system is not being altered, the mechanical system need not meet the *Standards*.

When No Envelope Design Is Submitted For Permit

When envelope compliance calculations are not required, you may turn off envelope credits and penalties as well as the envelope compliance forms for the project. In the Scope section of the Calculations Options for either the NR Prescriptive or NR T24 Performance module, leave the Envelope checkbox blank.

When Envelope calculations are not selected, the envelope modeled in the Standard Design is the same envelope modeled for the Proposed Design. This is especially important in tenant improvement spaces in which there are no envelope changes and you are using the performance method.

When No Lighting Design Is Submitted For Permit

When indoor and/or outdoor lighting compliance calculations are not required, you may turn off lighting credits and penalties as well as the lighting compliance forms for the project. In the Scope section of the Calculations Options for either the NR Prescriptive or NR T24 Performance module, leave the Indoor and/or Outdoor Lighting checkboxes blank.

NOTE: When lighting plans are being submitted for only certain portions of the permitted space, check (Proposed Lighting) Use Installed LPD under the Zone Lighting tab for zones with plans. For zones without lighting plans submitted, check Use Standard LPD (No Plans).

When No Mechanical Design Is Submitted For Permit

When mechanical compliance calculations are not required, you may turn off mechanical system credits and penalties as well as the mechanical compliance forms for the project. In the Scope section of the Calculations Options for either the NR Prescriptive or NR T24 Performance module, leave the Mechanical checkbox blank.

Inputting Zones By Thermal Characteristics and Occupancy Type

One of the most important questions to answer before taking off floor areas and other information from the drawings is: How many different Zones are necessary to properly model the building -- the conditioned permitted space?

To find the answer, you must first understand what is needed to capture the effect of different thermal zones within a system or within a building as a whole.

Rule 1a: If the actual system(s) and zoning of the building is known at the time of the performance calculation, use the actual zoning and system(s). This is the most accurate and straightforward approach, and should be used whenever possible and practical. If the building has twenty thermostats or less, you must model one zone for each independent thermostat. Any area that is considered one zone must maintain a well-balanced distribution of heating and cooling.

Rule 1b: If the building has more than twenty thermostatically controlled zones, and the zoning of the building is too convoluted and/or cannot be modeled as-is, you may make some simplifying assumptions in which you merge thermodynamically similar zones within the same system, or within a group of identical systems (e.g., packaged units) all serving thermodynamically similar zones. Thermodynamically similar zones must be able to use a single thermostat or HVAC-controlling device or sensor to maintain physical comfort. Typically, physical zones which have the same or similar glazing orientation(s), the same or similar glazing area to floor area ratio and the same occupancy types will be thermodynamically similar since, for example, they experience their peak cooling loads at the same hour.

The methods of combining thermal zones shall be consistent with the definition for Zone, Space Conditioning in Section 101(b) of the Standards, which states that a space conditioning zone "is a space or group of spaces within a building with sufficiently similar comfort conditioning requirements so that comfort conditions, as specified in 144(b)3 or 150(h), as applicable, can be maintained throughout the zone by a single controlling device."

An example of similar zones are central core areas on multiple floors of a multi-story building. An example of dissimilar zones is a perimeter area on one facade of a building, part of which includes a large amount of glazing, and part of which has no glazing. If these areas are in fact independently controlled, they should be treated as two zones even though they are on the same floor and facing the same orientation.

Rule 1c: If no reliable information about the actual system(s) and zoning of the building is known, the building shall be considered to have 12.5 feet (3.81 meter) perimeter zones and a central core zone that is greater than 15 feet (4.6 meters) from the exterior walls of the building. Any building or separate permitted space smaller than 2,500 square feet (232.3 square meters) in conditioned floor area may be modeled as having only a single HVAC zone.

For buildings that are larger than 2,500 square feet, the procedure for determining the perimeter zone area (as described in the 2008 Nonresidential ACM manual), is as follows.

1. Determine the ratio (R) of the floor's total conditioned area to the gross exterior wall area associated with the conditioned space.
2. For each combination of occupancy type and exterior wall orientation create a perimeter zone. The floor area of each perimeter zone shall be the gross exterior wall area of the zone times R or 1.25, whichever is less.
3. Model the exterior space adjacent to each wall orientation as a separate exterior zone. Spaces adjacent to walls which are within 45 degrees of each orientation shall be included in the zone belonging to that orientation.
4. For cases where R is greater than 1.25, create an interior zone for each occupancy type. For each occupancy type, the floor area of the interior zone shall be the total area less the floor area of the perimeter zones created in paragraphs 2 and 3 above.
5. Prorate the roof area and the floor area among the zones according to the floor area of each zone. Prorate the roof and floor areas among the perimeter zones created in paragraphs 2 and 3 above according to the floor area of each exterior zone.
6. Assign skylights to interior zones. If the skylight area is larger than the roof area of the interior zone, then the skylight area in the interior zone must be equal to the roof area in the interior zone and the user must prorate the remaining skylight area among the perimeter zones based on the floor area.
7. If the area of the zone is less than 300 ft^2 (27.9 m^2), combine it with its adjacent zone of the same occupancy type and zone type (interior or exterior).

8. Courtyards are considered outside or ambient air. Walls, floors, and roofs separating conditioned spaces from courtyards are exterior walls, floors, and roofs. Create an exterior zone for each wall orientation separating the conditioned space from the courtyard. The user shall not combine these exterior zones with other exterior zones even if their exterior walls have the same orientation.
9. Model spaces adjacent to demising walls as interior zones. Combine these zones with other interior zones within the same occupancy type.
10. Ignore all interior walls and model partitions separating thermal zones as air walls with U-factor of 1.0 Btu/h-ft$_2$-^{o}F.

If a building has more than one story, the core zone of the top floor should be a separate zone from the core areas of the middle and ground floors. Likewise, the core area of the ground floor should be a zone separate from the middle or top floor and an exterior roof/ceiling.

Since the California Energy Commission considers a larger number of modeled HVAC zones to be a more accurate representation, local enforcement agencies may at their own discretion require the permit applicant to model additional HVAC zones up to the limits of the ACM capabilities.

NOTE: The standard design which sets the energy budget for the building uses exactly the same zoning and interzone surfaces as the proposed design.

Rule 2: If each zone designated according to Rules 1a, 1b and 1c has more than one occupancy type, subdivide the zones further according to lighting area categories and special ventilation requirements.

With the exceptions of tailored lighting allotment, tailored ventilation, and process loads described below, the program normally uses the occupancy type selected to internally fix specific modeling assumptions in the standard design to calculate the energy budget and in the proposed design to calculate energy use. These modeling assumptions, which are listed in Table N2-5, of the Nonresidential Manual are as follows:

- ☐ Square feet per occupant (listed in Table N2-5 as occupants per 1,000 ft² (92.9 m²)
- ☐ Sensible heat per occupant
- ☐ Latent heat per occupant
- ☐ Receptacle load in Watts per square foot
- ☐ Service hot water in Btuh per hour per occupant
- ☐ Lighting Watts per square foot
- Cfm per occupant (listed in Table N2-5 as cfm per sqft)

The general rules for dividing the building into Zones are as follows:

If more than 10% of a Zone in the building does not have the same "primary lighting function" (as explained in Chapter 5 of the Nonresidential Manual, and in Mixed Occupancy), you must:

Divide the Zone into smaller zones, each with its own proper occupancy type, which accurately models either the different lighting Area Categories shown in Table 146-E or 146-F of the Standards and/or the ventilation categories shown in Table 121-A of the Standards; or

Input a whole Zone associated with a particular HVAC System, selecting an occupancy type which most accurately models the occupant density and internal gain per occupant. Then, using the prescriptive lighting forms explained in Chapter 5 of the *Nonresidential Manual*, calculate the Tailored Allotment for lighting and input it under Lighting. You may also customize the ventilation rate in the Zone (that is, override the default ventilation rate shown in Table 4-3) by modifying the values under Occupant Density in the program, and setting Vent Type to Tailored.

The main point is that you must select occupancy type correctly since occupancy, in conjunction with the tailored lighting allotment, tailored ventilation, and process loads, set the energy budget for the building. Be

sure that the building is divided into zones which properly set an appropriate energy budget for lighting and ventilation in the standard design.

Any local enforcement agency may, at its own discretion, demand that the permit applicant provide special documentation or justification as to the reasonableness of the way in which the building has been zoned for the performance compliance calculation.

Standard HVAC System According To Proposed System Type

Based on the proposed HVAC system entered, the program chooses a standard default system for the standard design which is run to set the annual energy budget. Table N2-13, from the 2008 Nonresidential ACM Manual, lists the five mechanical system types from which the software selects a system for the standard design. Refer to the Nonresidential ACM Manual for detailed information on the standard system type and characteristics assumed for a variety of proposed system types.

Modeling Like HVAC Systems Together

You may model like systems together as one system provided the following conditions are met:

1. The zones served by the individual units meet the requirements of thermal zones as described in Inputting Zones by Thermal Characteristics and Occupancy Type; and
2. The equipment is all of the same category. Multiple units of the same type must fall into one of the specific categories contained within the following pop-up listings:

   Cooling Equipment

   Heating Equipment

   Fan Systems

   Water Heaters

Unconditioned Zones

Lighting in unconditioned zones must meet the Standards requirements. However, in most other cases, modeling unconditioned zones is optional, though it is recommended so that mechanical systems do not appear to be oversized.

To model an unconditioned zone:

1. Create a Zone within the System which shares the most heat transfer to and from the conditioned space. In the program, give it a name (e.g., “Warehouse”) and set the occupancy type to Unconditioned.
2. Enter the floor area and ceiling height.
3. Set the Desired Winter Temperature to an appropriate actual winter temperature (e.g., 50□F or 10.0□C) and the Desired Summer Temperature to an appropriate actual summer temperature (e.g., 90°F or 32.2□C). Do not leave the settings for an unconditioned space at the settings for a conditioned space.
4. Input the major exterior surfaces of the unconditioned zone, such as roof and exterior walls. It may not be necessary to model relatively small areas of glazing.
5. Create demising partitions in the adjacent conditioned zones to model all surfaces (roof, walls, floor) between conditioned Zones and unconditioned Zones using the Interior Surface element.

NOTE: Include Demising Partitions as part of the adjacent conditioned space, not part of the unconditioned space.

Demising Partitions

To link an unconditioned space to a conditioned space, you must model an Unconditioned Space (Zone) before you create Demising Partitions for the conditioned space, so that the name (e.g., Warehouse) will appear in the Adjacent To drop-down list. Demising Partitions do not have an azimuth or true exterior orientation; instead they are linked to enclosed, unconditioned spaces.

Demising partitions are defined in the *Standards* as "solid barriers that separate conditioned space from enclosed unconditioned space". Thus there are demising walls, demising ceilings and demising floors, all of which may be modeled using the Interior Surface element within the appropriate conditioned space. (The Interior Surface element has a default tilt of 90 degrees, i.e., a wall. You must change the tilt for ceilings and floors, as noted below.) Demising partitions also separate return air plenums from conditioned spaces.

From Section 4.3.3.1 of the Nonresidential ACM Manual, "Demising partitions (usually walls) must either be modeled as shaded exterior partitions or as a partition that separates conditioned and unconditioned space. They are modeled as interior walls constructed according to the plans and specifications for the building. If the enclosed unconditioned space is not included in the permit, the demising partition shall be modeled as a shaded exterior wall unless it is a "party wall" separating tenant spaces. A "party wall" can be modeled as an adiabatic wall for both the standard and the proposed buildings if it has R-13 between framing members or has a U-factor of less than 0.213."

Model demising partitions as follows:

First create one or more Unconditioned Zone(s).

Then, in the adjacent conditioned space(s), use the Interior Surface element to create a demising ceiling, wall, or floor. Name the partition to identify it (e.g., "Wall to Warehouse") and input all the actual characteristics (Assembly, Area, etc.). Set the absorptivity to 0. For Adjacent To, select from the drop-down list the name of the Unconditioned Space (e.g., Warehouse) adjacent to the demising partitions.

NOTE: Model a demising partition only from within a conditioned zone. Do not, for example, model a demising wall in an office zone to an unconditioned warehouse zone, and also model the same demising wall in the warehouse linked back to the office.

Underground Walls and Floors (Nonresidential)

Model nonresidential underground (berm) walls as follows:

- ☐ Insert an Underground Wall element and enter the name and area. Select a Wall assembly from the Assembly Library. See Joint Appendix JA4 for additional information regarding wall construction assemblies, and Section 4.1.4 of the Appendix for information about insulation on either the interior or exterior mass walls.
- ☐ Enter the depth (in inches) that the wall extends below grade.

Use the same method to model nonresidential Underground Floors with the Underground Floor element.

All underground walls and floors are considered compliance neutral. There is no credit or penalty associated with underground elements.

In nonresidential load calculations, heat loss for underground assemblies is calculated by multiplying the U-Factor by the area. (Heat loss for slab-on-grade elements is calculated using slab edge loss.)

Refer to the topic Underground Walls and Floors (Residential) for modeling details in low-rise residential calculations.

Return Air Plenums

A return air plenum is an unoccupied space within the insulated building envelope through which air flows back to the space conditioning system from the space(s). The return air temperature is usually within a few degrees of the conditioned space temperature, and is considered conditioned space. Model return air plenums as part of the adjacent conditioned space. Model the correct geometry of the Zone, including its area, height, adjacency to other Zones, and any exterior surfaces.

T-Bar Ceilings

Placing insulation directly over suspended ceilings is not permitted as a means of compliance, except for in limited applications. The following excerpt from Section 118 of the Standards describes the conditions under which placing insulation over suspended ceilings is allowed for Title 24 compliance.

> *"Exception to §118(e)3: When there are conditioned spaces with a combined floor area no greater than 2,000 ft² in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 ft, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations."*

Refer to the Joint Appendix JA-4, and Section 3.3.1 of the Nonresidential Manual for additional information regarding insulating a ceiling with removable panels.

Process Loads

Process loads (i.e., sensible and/or latent process loads) are input in each Zone with the Room element, under the Receptacle/Process tab. They are included in the NR Loads calculation for sizing mechanical equipment, and are also modeled in the NR T24 Performance compliance runs in both the Standard Design and the Proposed Design.

Because process loads are passed through in both the prescriptive and performance approaches, they are neither an energy penalty nor an energy credit in meeting the *Standards*.

For any particular occupancy, subtract the normal equipment load from the total process load to determine the (net) sensible process load input into the program. For example, if there is a computer room with 4.0 watts/ft² (43.0 W/m²), you may assume a normal equipment or receptacle load of 1.5 watts/ft² (16.1 W/m²) and a sensible process load of (4.0 - 1.5) = 2.5 watts/sqft [(43.0 - 16.1) = 26.9 W/m²]. If you are unsure as to what value to use for equipment, consult Table N2-5 for standard occupancy assumptions automatically used with the performance calculations.

Tailored and Process Ventilation

The *Standards* require a minimum mechanical ventilation rate to be provided in all conditioned zones when natural ventilation [as defined in Section 121(b)1] cannot be met. Specifically, the *Standards* require outdoor air to be provided in accordance with Table No. 121-A of the Standards, or 15 cfm (7.1 L/s) per person times

the number of occupants, whichever is a higher ventilation rate. The number of occupants shall be the number of fixed seats in occupancies which include fixed seating, or an occupant density no less than one-half the occupant density assumed for exiting purposes in Chapter 33 of the UBC, times the area of the zone.

Table 4-3 lists correct input values to use for ventilation for a variety of nonresidential occupancies.

As explained in the Zone Element, Mechanical tab, CEC *Standards* set the ventilation to the value in Table N2-5 for the NR T24 Performance calculation, and set Occupant Density and Ventilation (cfm per Occupant) to the values specified in the NR Loads calculation. When Vent Type is set to Tailored, the program uses the actual Occupant Density and Ventilation (cfm per Occupant) in both NR Loads and NR T24 Performance compliance calculations. You may be required to demonstrate justification for tailored ventilation rates by the local enforcement agency.

Process ventilation, to the extent that it requires the heating and cooling of outside air to remove fumes or other special contaminants, may be included in the total ventilation rate entered as an Occupant Density and Ventilation (cfm per Occupant).

Process ventilation and the fan power associated with it may be ignored in compliance calculations because the *Standards* exempt the energy use of fans associated with fume hood exhausts and air filtration systems (see the *Nonresidential Manual* Section 4.6.6). Adjust the fan power for fans which serve both process load and provide space conditioning using the equation in the Standards, Section 144(c).

Exhaust Fans

Exhaust fans must be modeled for compliance calculations, including exhaust fans in kitchens, conference rooms, workrooms, computer rooms and storerooms. Exhaust fans that are manually controlled (such as bathroom fans) may not operate at design conditions and therefore shall **not** be included in the fan system power demand calculations.

Fume hood exhausts, relief fans and exhaust fans associated with economizers that do not operate at peak conditions are exempt, as are all fans that move only unconditioned air.

To model exhaust fans:

Create or modify exhaust fans in the Room Element, Exhaust Fan tab. Enter an Exhaust Fan Multiplier to specify the number of fans in the Room.

Nonresidential Fenestration

Manufactured Site-Built Field-Fabricated NFRC CMA Program Mixed Types

Title 24 requires that nonresidential fenestration products be certified to comply with the mandatory requirements in Section 116 of the Standards. The requirements include maximum allowed air leakage, methods for calculating the U-Factor and SHGC, labeling, and acceptance requirements.

Specific requirements vary according to the specific fenestration product type. The definition of each type, from Section 101 of the Standards, is shown below.

> ***"FENESTRATION PRODUCT, MANUFACTURED** is a fenestration product constructed of materials which are factory cut or otherwise factory formed with the specific intention of being used to fabricate a fenestration product. A manufactured fenestration product is typically factory-assembled before delivery to a job site. However a "knocked down" or partially assembled product sold as a fenestration product is also a manufactured fenestration product when provided with temporary and permanent labels as described in Section 10-111; otherwise it is a site-built fenestration product when provided with temporary and permanent labels as described in Section 10-111.*
>
> ***FENESTRATION PRODUCT, SITE-BUILT** is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing*

units. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.

***FENESTRATION PRODUCT, FIELD-FABRICATED** is a fenestration product including a glazed exterior door whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration with a label certificate or products required to have temporary or permanent labels."*

Manufactured and site-built fenestration products must have a temporary label, and those that are rated using the NFRC Rating Procedure (NFRC 100 for U-Factors, and NFRC 200 for SHGC) must also have a permanent label (or an NFRC label certificate).

Manufactured (Factory-Assembled) Fenestration Products

If manufactured fenestration products are not rated and labeled using the NFRC Rating Procedure, they must use the default values for U-Factor from Table 116-A, and for SHGC from Table 116-B of the Standards. See Sections 10-111 and 116 of the Standards, and Section 3.2.1 of the Nonresidential Manual for additional information regarding mandatory requirements for fenestration products.

Site-Built Fenestration Products (and Skylights)

This section describes the two methods for documenting thermal performance (U-Factor, SHGC) for site-built fenestration products. Site-built fenestration must have either a NFRC Label Certificate or use the default values listed above. The total site-built fenestration area includes windows, non-opaque doors, and skylights.

Before an occupancy permit is granted site-built fenestration products in other then low-rise residential buildings shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7 to ensure that site-built fenestration meet Standards requirements, including a matching label certificate for each product installed and be readily accessible at the project location.

Projects with less than 10,000 square feet of site-built fenestration:

If the values are NFRC-certified, you may use the certified values for compliance purposes. Otherwise, you must either use the CEC default values in Section 116 of the Standards or the values resulting from the alternate default equations for calculating fenestration thermal performance from Reference Appendix NA6-2008. Refer to the Appendix for additional information regarding the compliance-related responsibilities of energy consultants, designers, architects, builders, installers, and enforcement agencies when using the procedures in NA6-2008.

Projects with more than 10,000 square feet of site-built fenestration:

Fenestration products in these projects must either have a NFRC label certificate or use the default values in Section 116 of the Standards. NFRC label certificates can substitute for the temporary and/or permanent label for site-built fenestration products.

NFRC Component Modeling Approach (CMA) Product Certification Program

The following text is an excerpt of Section 3.2.1 of the Nonresidential Manual:

"The National Fenestration Rating Council ("NFRC") has developed a new commercial certification product program that rates whole fenestration products to include site-built fenestration in accordance with NFRC 100 and NFRC 200. This new approach determines the U-factor, Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) of a product faster and more accurately without actual physical laboratory testing in most cases. Such

results can be used in a pre-bid report or for other energy performance analysis, and is used for obtaining an NFRC CMA Label Certificate.

Each component that makes up a fenestration product shall have values that are NFRC-approved and maintained by NFRC. NFRC's Approved Component Library Database includes the glazing, spacer and frame components. Each of the components is NFRC certified before they are inputted into the library's database.

The component manufacturers shall have their products approved by NFRC in accordance with the new NFRC 705-2009 Component Modeling Approach Product Certification Program (CMA-PCP). Before the components can be accepted into the Component Library Database they must be first verified by an Independent Certification and Inspection Agency (IA), which has been licensed by NFRC."

Note that the report generated by the NFRC's CMA software contains non-certified performance data. This report IS NOT an NFRC-Approved Label Certificate. Refer to the NFRC web-site at http://www.nfrc.org or Section 3.2.1 of the Nonresidential Manual for additional information about the CMA program and obtaining a label certificate.

Field-Fabricated Fenestration

Field-fabricated fenestration and field fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance using U-factors from Standards and SHGC values from Standards Table 116-B. No labeling is required for field-fabricated fenestration products.

Mixed Fenestration Types

If mixed fenestration is included in the compliance analysis, then the compliance submittal must demonstrate which are certified fenestration products and which are non-certified fenestration or site-assembled fenestration products. The manufacturer's documentation and calculations for each product must be included in the submittal, and either the ENV-1C or PERF-1C form must be included on the building plans.

Tight Ducts in Nonresidential Occupancies

The prescriptive requirements for some nonresidential HVAC duct systems include duct sealing and leakage testing. The prescriptive requirement applies when:

- The system is constant volume
- It serves less than 5,000 sqft of conditioned space
- 25 percent or more of the duct surface area is located in the outdoors, unconditioned space, a ventilated attic, in a crawl space or where the U-factor of the roof is greater than the U-factor of the ceiling except where the roof meets with the requirements of Section 143(a)1C.

The standard design for systems with the characteristics above assumes duct leakage is 6% of total fan flow. If the leakage is field verified by a certified HERS rater, you may claim compliance credit for reduced duct leakage if the leakage is diagnostically measured and verified to be less than 6% of fan flow.

The leakage requirements apply to new duct systems, new ducts on existing systems, and to existing ducts on existing systems that are being repaired or replaced. In addition, if the requirements apply when an existing HVAC system is repaired or replaced.

If the new ducts are an extension of an existing duct system the combined system (new and existing ducts) must meet:

1. A leakage rate of < 15 percent of fan flow, or

2. A reduction in leakage rate of > 60 percent (as compared to the existing ductwork) with all "accessible" leaks demonstrated through visual inspection to have been sealed, or

3. All accessible leaks shall be sealed and verified through a visual inspection by a certified HERS rater.

Refer to Sections 144 and 149(b)1E of the Standards, Section 4.4.2 of the Nonresidential Manual, and to Reference Nonresidential Appendix NA2 for additional information regarding nonresidential duct leakage requirements.

NOTE: One can avoid sealing the ducts by insulating the roof and sealing the attic vents as part of a larger remodel, thereby creating a conditioned space within which the ducts are located, and no longer meets the criteria of §144(k).

Tailored Lighting Calculations

Use **EnergyPro** to quickly and easily document compliance using the Tailored Method. Based on your task and activity selections and other descriptive characteristics, **EnergyPro** automatically calculates the maximum Allowed Lighting Power as well as the Proposed design LPD. A main concept of the prescriptive lighting approach is that the permit applicant has the option of establishing a lighting allotment (or allowable lighting power density) for the conditioned permitted space by completing forms which document lighting needs *tailored* to the specific lighting requirements of the building or area.

The Tailored Method is one of three Prescriptive methods for determining the Allowed Lighting Power for a project; the others are Complete Building and Area Category Method. Because the Tailored Method is based on task activities, this method requires the most detail on the plans, and in some cases, requires documentation of the actual lighting tasks.

Section 5.3.3 of the Nonresidential Manual states:

> *"The Tailored Method has several components (wall display, floor display, ornamental and very valuable display lighting) that are "use it or lose it" allowances. As a result, if a lighting design does not include these components, the allowed wattage under the Tailored Method may be less than if the Area Category Method or Whole Building Method of compliance is used. Allowed lighting power may be traded from Primary Function areas using the Area Category Method to Primary Function areas using the Tailored Method. However, trade-offs may not be traded from the Tailored Method to the Area Category Method."*

Using EnergyPro to Calculate Prescriptive Tailored Lighting Compliance

In the Room Element, General Tab, enter the room characteristics, including the area and ceiling height. In the Lighting Tab, click on the Activity Button to select the appropriate room activity (for example, Display - Gross Sales Floor Area) from the list.

Enter all other pertinent information in the dialog box. The Room Dimension, task height and mounting height are used by the program to calculate the RCR. If the room is rectangular, enter the room length and width. If not, enter the perimeter. If you enter a perimeter value, the length and width values will be overridden. If the mounting height is equal to or greater than 15 feet (4.6 meters), **EnergyPro** automatically applies the appropriate Mounting Height Multiplier to the assigned LPD value.

Add a Task Element and complete the required information for each specific task within the room. Then, Add as many Lighting Elements as necessary to define all light fixtures dedicated to that task.

In the Lighting Tab of the Zone Element, set the Standard Lighting to Use Calculated Tailored LPD and Proposed Lighting to Use Installed LPD. In the appropriate NR Calculations Options, check the Indoor Lighting checkbox to include Indoor Lighting in the simulation scope.

Refer to Section 146 of the Standards and 5.3.3 of the Nonresidential Manual for additional information about tailored lighting calculations. In addition, refer to Table 146-G in the Standards for information regarding the lighting power allowances for display and decorative lighting.

Title 24 Daylighting Requirements

The 2008 Standards require that lowrise nonresidential buildings located in Climate Zones 2 -15 that are larger than 8,000 square feet and are located directly under a roof include a certain percentage of skylights to take advantage of natural daylight.

Section 143(c) of the Standards states:

> *"(c) Minimum Skylight Area for Large Enclosed Spaces in Buildings with Three or Fewer Stories. In climate zones 2 through 15, low rise conditioned or unconditioned enclosed spaces that are greater than 8,000 ft2 directly under a roof with ceiling heights greater than 15 feet shall meet Sections 143(c)1-4 below.*
>
> *1. Daylit Area. At least one half of the floor area shall be in the skylit daylight area, the primary sidelit daylight area, or a combination of the skylit and primary sidelit daylight areas. The skylit and primary sidelit daylight areas shall be shown on the building plans. Skylit and primary sidelit daylight areas are defined in Section 131(c)1.*
>
> *2. Minimum Skylight Area or Effective Aperture. Areas that are skylit shall have a minimum skylight area to skylit area ratio of at least 3.3 percent or minimum skylight effective aperture of at least 1.1 percent. Skylight effective aperture shall be determined as specified in Equation 146-C. If primary sidelit area is used to comply with Section 143(c)1, the primary sidelit daylight areas shall have an effective aperture greater than 10 percent. The effective aperture for primary sidelit daylight areas is specified in Section 146(a)2E.*
>
> *3. Skylight Characteristics. Skylights shall:*
>
> *A. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, tested according to ASTM D1003 (notwithstanding its scope) or other test method approved by the Commission; and*
>
> *B. If the space is conditioned, meet the requirements in Section 143(a)6 or 143(b).*
>
> *4. Controls. Electric lighting in the daylit area shall be controlled as described in Section 131(c)2.*
>
> *EXCEPTION 1 to Section 143(c): Auditoriums, churches, movie theaters, museums, and refrigerated warehouses.*
>
> *EXCEPTION 2 to Section 143(c): In buildings with unfinished interiors, future enclosed spaces where it is planned to have less than or equal to 8,000 square feet of floor area, or ceiling heights less than or equal to 15 feet, based on proposed future interior wall and ceiling locations as delineated in the plans. This exception shall not apply to these future enclosed spaces when interior walls and ceilings are installed for the first time, the enclosed space floor area is greater than 8,000 square feet, and the ceiling height is greater than 15 feet (see Section 149(b)1M). This exception shall not be used for S-1 or S-2 (storage), or for F-1 or F-2 (factory) occupancies.*
>
> *EXCEPTION 3 to Section 143(c): Enclosed spaces having a designed general lighting system with a lighting power density less than 0.5 watts per square foot."*

Modeling Daylit Zones

In the Central System Element, check the checkbox indicating the space must meet the mandatory daylighting requirements (Space > 8,000 sqft and Ceiling Height >15 feet…).

In the Lighting Tab of the Room Element, describe the activity type and the room features. You must enter Room Dimensions and the Sidelit and/or Skylit Areas, as applicable. EnergyPro automatically calculates the Room Cavity Ratio and Effective Aperture for each area.

Finally, in the Lighting Element, enter the lighting system data and the type of control, e.g., Window Daylighting or Window Daylighting with Occ Sensor.

If your project will claim compliance credit for the controls in both the primary and secondary daylit zones, you may wish to model a second room for the secondary daylit zone.

Refer to Sections 131 and 143 of the Standards and Chapter 5 in the Nonresidential Manual for details regarding the daylighting requirements and how to calculate the primary and secondary daylighting zones.

Mandatory Measures

Specific mandatory features must be installed in all new buildings and additions. These measures must be installed regardless of which method is used to demonstrate compliance. Mandatory measures may be superseded by other more stringent requirements in the prescriptive or performance method.

EnergyPro prints a Mandatory Measures Form for residential buildings (Form MF-1R) for each project. For an explanation of the low-rise residential mandatory measures, refer to the relevant sections of the Residential Manual.

Nonresidential mandatory measures are split into envelope, lighting and/or mechanical mandatory measures. You must select the appropriate mandatory measures to include in your report based on the project scope. For an explanation of the nonresidential mandatory measures, refer to the relevant sections of the Nonresidential Manual.

Additions

Additions are common construction projects that are considered new construction under Title 24. As defined in Section 101(b) in the Standards, an addition is “any change to a building that increases conditioned floor area and conditioned volume. See also “newly conditioned space.” Addition is also any change that increases the floor area or volume of an unconditioned building of an occupancy group or type regulated by Part 6. Addition is also any change that increases the illuminated area of an outdoor lighting application regulated by Part 6”.

Refer to Chapter 8 of the Residential Manual for a discussion of low-rise residential additions. The Nonresidential Manual contains a general summary of the addition requirements in Section 1.7.14, and more specific information in each of the relevant chapters.

You may use any one of three options to document compliance of an addition:

- ☐ Addition Alone: Demonstrate that the addition alone meets the energy budget for new construction;
- ☐ Existing Plus Addition Plus Alteration: Demonstrate that the existing building plus the addition and/or alteration meets the energy budget by using the same or less energy than the existing building plus an addition that meets the current standards energy budget for new construction.

- Whole Building: Demonstrate that the whole building, including the addition complies with the current standards.

For reasons of stringency, the last option is rarely used. The first option is the most straightforward approach when the addition is able to comply with that approach, and is especially recommended in nonresidential buildings. Although it is the most lengthy to calculate and document, the second alternative provides the most flexibility in showing compliance of the addition. **EnergyPro** accommodates any of these compliance options for additions.

Analysis of Addition Alone

Any addition--that is, the sum of all newly conditioned spaces and associated new exterior walls, ceilings, and floors within the building--may be shown to meet the energy budget as a separate entity. This procedure does not involve the existing structure and may be performed using the Res T24 Performance calculation for low-rise residential buildings, or either of the NR T24 Performance or NR T24 Prescriptive calculations for nonresidential buildings.

The rules and overall approach for analyzing an addition alone are the same as for showing compliance of any new building:

1. Enter all the building and system characteristics and meet the appropriate energy budget.
2. Use the program exactly as you would for a new building, but select Addition in the Project Design Data tab of the Building element.
3. In the Project Title tab, name the project to show that it is only the Addition you are modeling, e.g., Wu Residence, Addition Only.

Analyzing additions alone works well for relatively large additions with moderate amounts of glazing. It may be difficult to achieve compliance in this way with small additions, because they tend to have a higher glazing-to-floor area ratio than an entire residence, which boosts the energy consumption per square foot. If an addition alone does not comply with the Standards, improvements to the Existing building may be necessary in order for the addition to comply as explained in the Existing-Plus-Addition-Plus-Alteration approach. The Addition Alone method cannot be used when alterations to the existing building are required to compensate for failure of an addition to comply alone or when alterations to the water heating system are proposed. In these events, either the Whole Building or the Existing + Addition + Alteration approaches can be used.

Existing-Plus-Addition-Plus-Alteration Analysis

Probably the most flexible method for showing compliance of an addition with the Standards is to consider the existing building along with the addition. By comparing building energy consumption before and after the addition, you may take credit for improvements to the efficiency measures in the existing building under certain conditions.

Residential Projects: When using the prescriptive approach, each altered component must meet or exceed the requirements of Standards Section §152(b)1 for that component. When the performance approach is used, the altered component must meet or exceed the requirements in §152(b)2, or another alteration(s) must be made to the existing building, which exceeds the requirements of §152(b)2 that saves the additional energy necessary to at least make up for the alteration(s) that fail to meet 152(b)2.

In other words, to receive full credit for improving the energy performance of any altered component, the Standards now require that the altered components meet either the mandatory or prescriptive performance level. If the altered component meets the requirement, the energy budget is based on the existing condition. However, if the altered component does NOT meet the requirement, the budget is based on the mandatory or prescriptive requirement (thus resulting in a penalty). The requirement varies depending on the component; please refer to Section 152(b)2 or Chapter 8 of the Residential Manual for additional details regarding additions and alterations.

Nonresidential Projects: The proposed energy budget is calculated based on existing building features that remain unaltered, and all alterations (actual values of the proposed alterations), plus the proposed addition. The standard (allowed) budget is calculated based on the existing building features that remain unaltered, and all proposed alterations modeled to meet the requirements of §149(b)2B (these are generally mandatory or prescriptive requirements for mechanical, envelope, and lighting systems), plus the addition modeled to meet the requirements of §141.

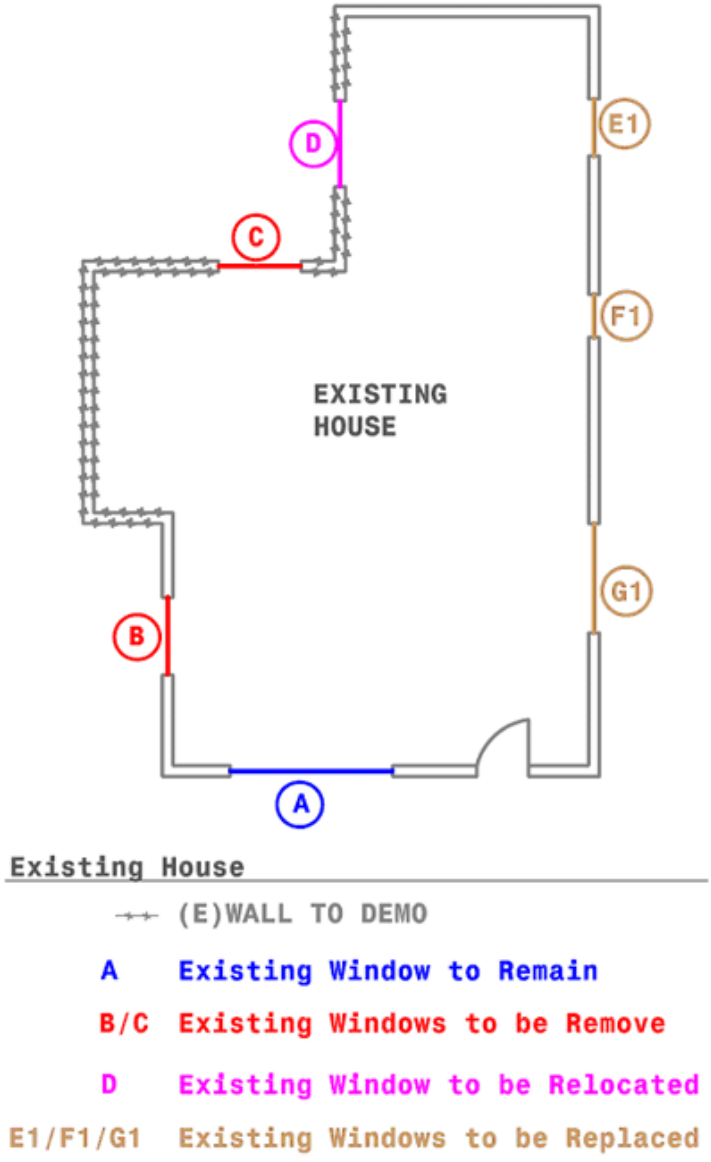
If the altered component meets the requirement, the energy budget is based on the existing condition. However, if the altered component does NOT meet the requirement, the budget is based on the mandatory or prescriptive requirement (thus resulting in a penalty). The requirement varies depending on the

component; please refer to Section 152(b)2 or Chapter 8 of the Residential Manual for additional details regarding additions and alterations. Refer to Sections 1.7.13 and 1.7.14 of the Nonresidential Manual for additional details regarding additions and alterations generally, and to the relevant chapter for information about a specific component or end use.

Functionally, residential and nonresidential additions use essentially the same process to show compliance with this approach. To show compliance with this approach, complete the following steps. The following example demonstrates the procedure for a residential building using Res T24 Performance. It also applies to a nonresidential occupancy with NR T24 Performance.

You may view a sample EnergyPro file of the existing plus addition plus alteration method. From the File menu, open the Existing+Alteration+Addition.bld file located in the Projects folder. The following two diagrams show the existing house and the house as it will be permitted.

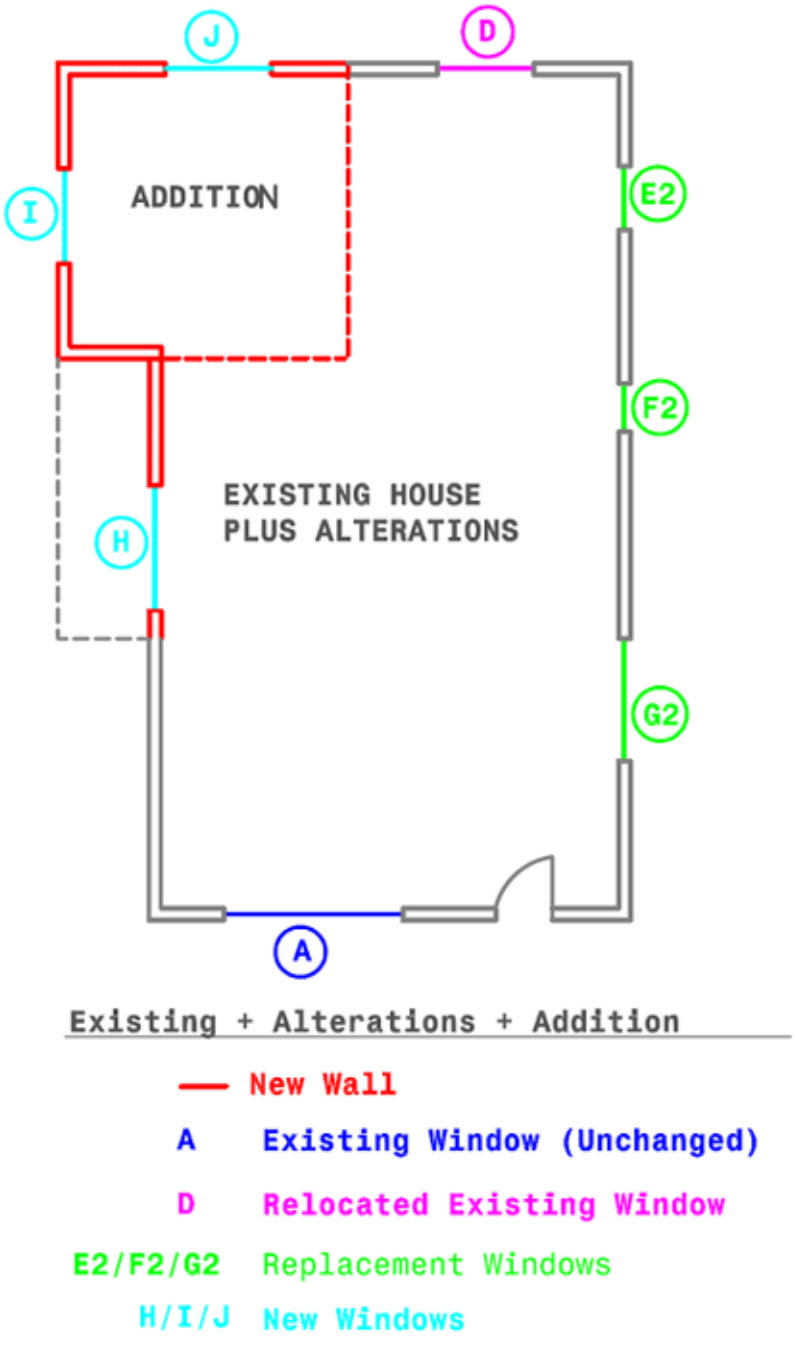
Figure A. Existing House



A single model will contain all of the information, meaning that all of the information for the existing house including that which will be altered or removed as well as the Addition information. Each Building Tree

element (Room, Window, Wall, HVAC, DHW, etc..) will include a designation of the element Type that properly explains the role the element is playing in the calculation.

Figure B. Existing House, the Addition, and the Alterations

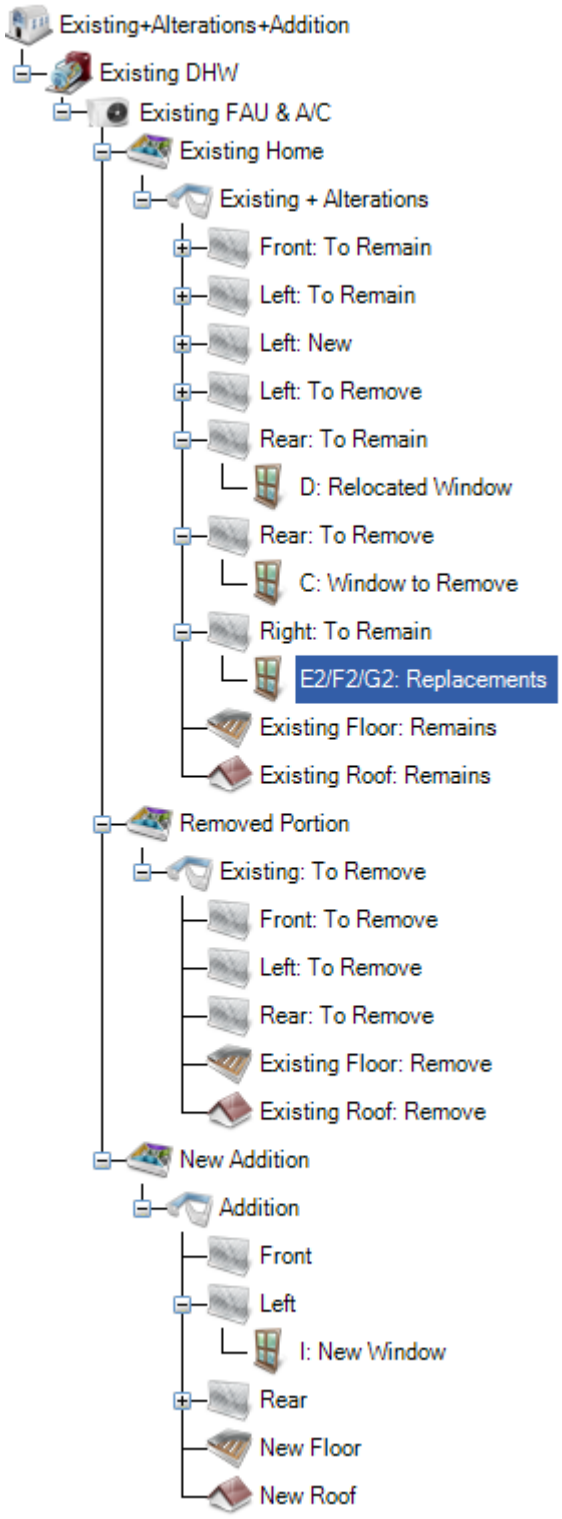


1. Compile complete information on the existing building before the remodel and information on the addition/alteration. If you are unsure of particular existing conditions, refer to Table R3-50: Default Assumptions for Existing Buildings or make a conservative assumption (i.e., in the direction of more efficiency as a base case).
2. Enter all the building characteristics, making sure that you:

Select Exist+Addition/Alteration as the Building Type in the Project Design Data tab.

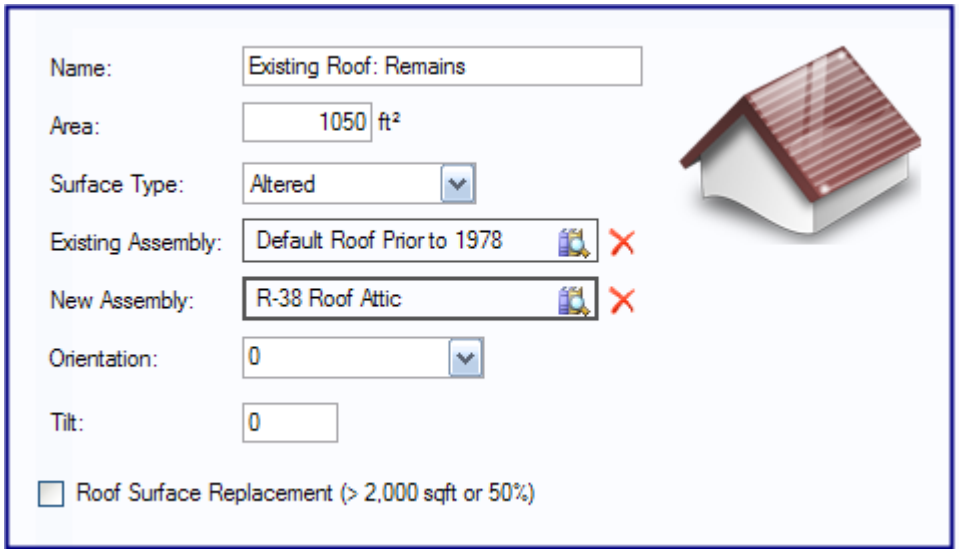
Name each Plant, System, Zone, Room , Room Components (when applicable) depicting the status of that item, i.e. for a wall that will be removed: “Existing Left Wall: Remove”. Figure C below is an example of a typical structure and naming convention for the project:

Figure C: EnergyPro Building Tree Example



Each Building Tree component includes a field that requires you to specify the type of component or project: Existing, New, Altered, or Removed. Figure D below shows an example of a roof component that will be altered as part of the project.

Figure D. Altered Roof Type Example



When you select Altered, you must enter or select the existing component as it is prior to the alteration from the appropriate library. Then, enter or select the component as it will exist after the alteration. In this case, the existing roof uses the default insulation value from Table R3-50: Default Assumptions for Existing Buildings, and a new R-38 roof.

3. Calculate the energy performance of the building—for low-rise residential buildings, the Res T24 Performance Proposed Total— the NR T24 Performance Proposed Total for nonresidential performance calculations. Be sure to select both the Standard and Proposed runs for the building in the Calculation Options.

NOTE: When using this compliance approach it is important to take into account all changes in all walls, floors, roofs and glazing which are altered, removed from, or added to the existing house as part of the remodel. Wall, roof and floor areas become critical in this context, because credit may be gained by insulating previously uninsulated parts of the building envelope.

Mixed Occupancy Buildings

There are several ways to handle mixed occupancy buildings depending upon the occupancies involved, the relative areas of each occupancy, and how compliance is to be demonstrated.

As explained in Section 100(e), the *Standards* state that "when a building is designed and constructed for more than one type of occupancy, the zone for each occupancy shall meet the provisions of Title 24, Part 6 applicable to that occupancy."

Generally speaking, you must demonstrate compliance of each occupancy separately. For example, in a two-story building with 10,000 ft² (929 m²) of nonresidential space and a 1,500 ft² (139.4 m²) dwelling unit, the documentation for the low-rise residential occupancy portion of the building would be totally separate from the nonresidential reports even if the building is entered within the program as one entity with different zones and HVAC systems. Perhaps the clearest way to execute this using the program would be to print out two complete reports, each one for the applicable occupancy or occupancies within the same building. The title information should be clear to those reviewing the calculations.

A useful exception in the *Standards* to Section 100(e) is: "If one occupancy constitutes at least 90 percent of the conditioned floor area of the building, the entire building may comply with the provisions of Title 24, Part 6 applicable to that occupancy, provided that the applicable mandatory measures in Sections 110 through 139, and 150, are met for each occupancy."

When the exception is used, model the whole building within the program as the predominant occupancy. That is, include the area and features of the subordinate occupancy zone, but specify only the dominant

occupancy type. For example, a building which is 95% retail and 5% office may be modeled as if the entire building were retail space. In this case, the occupancy may be set to Retail throughout the building, even though you might wish to define a separate zone and/or HVAC system named Office to make clear its true occupancy.

Remember that if a zone is unconditioned, it is not included in the compliance calculations. However, an indirectly conditioned space is considered conditioned as defined in the Standards Section 101(b).

See the Nonresidential Manual for further information on mixed occupancy nonresidential buildings.

Mechanical Systems

EnergyPro can analyze a wide range of HVAC system types. Systems may have a number of different components which are input in different parts of the program. Mechanical system components are defined in the Central System, Zonal, Chillers, Towers, and Boiler Libraries. They are brought into specific building description files in various elements of the Building Tree.

Related Topics:

Central Systems

Default Mechanical Systems

Zonal Systems

Chillers and Cooling Towers

Space Heating Boilers

Case Studies

Central Systems

Every mechanical system modeled in **EnergyPro** needs at least one central system component. These include simple furnaces and air conditioners, as well as certain central components of more complex systems such as built-up VAV systems or hydronic heat pumps. Table D-4 lists all of the primary system types available in the program and their central system inputs.

Central systems are defined in the Central System Library and are brought into specific building description files in the System Element.

Each central system may include both heating and cooling equipment. Some mechanical systems, particularly those used in low-rise residential buildings, may be completely defined as central systems. Examples include typical gas furnaces and air conditioners. Such systems do not require any other Library inputs.

When to Use and How to Create Default Mechanical Systems

There is a situation when you may want to use the NR T24 Performance/DOE calculation but want to model a default or minimum efficiency mechanical system. For example, when you model only a part of a building (e.g., a tenant space) which is served by a central boiler, central chiller and/or central cooling tower, you can create a default HVAC system for the proposed building.

Default HVAC System

To model a default HVAC system, simply set the HVAC input of the System element to "Undefined". NR T24 Performance will automatically define a packaged, single-zone system for both the standard and proposed designs.

For projects where a built-up system is the appropriate system type, you may use an alternative method to force the program to model the system type you select. In the Central System Library, Heating Tab, select the System Type from the drop-down list. Set all heating and cooling entries to zero. You may model the actual fan characteristics (if known) or model a fan power index equal to 0.365 Watts/cfm, which will be used for both the standard and proposed systems. Be sure to model sufficient supply air to meet the minimum ventilation requirements. NR T24 Performance will automatically define the type of system specified for both the standard and proposed designs.

Default Chiller

To model a default Chiller, simply set the Chiller input of the Plant element to "Undefined". NR T24 Performance will automatically define a chiller for both the standard and proposed designs.

Default Central Cooling Tower

To model a default Cooling Tower, simply set the Cooling Tower input of the Plant element to "Undefined". NR T24 Performance will automatically define a cooling tower for both the standard and proposed designs.

Default Zonal Systems

When modeling a default built-up mechanical system with VAV boxes, reheating, or recooling, you must create default zonal conditions as well.

1. In the Zonal System Library, create, for example, a default VAV box (e.g., Std 30% VAV Box/Reheat). Set the Minimum Airflow Ratio to the appropriate value (e.g., 0.30), and indicate the presence or absence of a Reheat Coil depending on the default condition.
2. Save the Zonal system, and select it in the Zone element under the Mechanical tab, Zonal System Data.

Default Boiler

To model a default Boiler, simply set the Heating Boiler input of the Plant element, Heating Hot Water Tab to "Undefined". NR T24 Performance will automatically define a boiler for both the standard and proposed designs.

Zonal Systems

Zonal systems include different kinds of VAV (variable air volume) or variable refrigerant volume boxes. Zonal systems are defined in the Zonal System Library and are input in the Zone element(s) under the Mechanical tab.

Each zone may have up to 99 identical terminal units such as VAV boxes. Table D-4 lists which mechanical system types may include specific zonal components.

Chillers and Cooling Towers

Chillers and cooling towers are components of more complex systems, such as built-up VAV systems. They are generally found in larger nonresidential and high-rise residential construction. Chillers and cooling towers are defined in the Plant Library and are incorporated into the overall building description using the Chilled Water tab in the Plant element.

Default Built-Up Systems with VAV Boxes, Reheating, or Recooling

When modeling a default existing or expected built-up system, you must model relevant zonal system characteristics as explained in Default Mechanical Systems: Default Zonal Systems.

Each building can have four chiller types and one type of cooling tower, but there can be multiple identical units of each. Primary and secondary pump information and chiller EMS control data are also entered in the Plant Element.

Space Heating Boilers

Boilers may be used for space heating in both residential and nonresidential buildings. Define boilers in the Boiler Library, and then you may select the equipment in the Heating Hot Water Tab in the Plant element.

Each building may have only one type of boiler, although there may be more than one identical unit. The exception to this may be residential buildings with combined hydronic systems. They may have more than one boiler and/or water heater serving a single building.

Distribution Systems

The ducts and other distribution systems for mechanical systems can be input in the System element for each HVAC system. These inputs are most often used for low-rise residential compliance calculations, although distribution system type and any duct R-values are also documented in nonresidential compliance calculations when more than 25% of the ducts are located in unconditioned space or outdoors. For other nonresidential compliance calculations, the program makes certain fixed assumptions based on the HVAC system type.

Case Studies

This section presents several different mechanical systems and explains how to input them in **EnergyPro**. They are:

- ☐ Gas Furnace
- ☐ Packaged Furnace/AC with Exhaust Fans
- ☐ Packaged VAV without Reheat
- ☐ Built-up VAV with Reheat

These case studies are intended to demonstrate the general approaches used to input some different mechanical systems. Use them as guidelines for defining your own systems, understanding that each project will have somewhat different requirements.

Case Study 1: Gas Furnace

A residential building in Climate Zone 6 has a typical gas furnace with R-4.2 ducts in the attic and a setback thermostat. There is no cooling. How is this input?

Answer:

1. Define and save the furnace in the Central System Library, or confirm that the desired unit is already in the Library. You can use the CEC Equipment Directory Database to help input some of the furnace information. Return to the Building Tree.
2. In the General Tab of the System element, give the system a name (e.g., Whole House System), select the HVAC unit you created in the Central System Library, and enter the number of identical units in the Multiplier field. The remainder of the inputs on this tab are default values for residences.
3. In the Distribution Tab, select the duct location (default is Attic, Ceiling Ins, vented) the R-Value of the insulation (4.2), and check the Verified Duct Leakage checkbox (this is the prescriptive requirement, and requires HERS field verification). Since there is no cooling, you can ignore the cooling system inputs. Leave them set at default values.
4. In the Residential Tab, select Setback for the thermostat.
5. For Title 24 compliance, the operating schedule is set automatically. If the system isn't being modeled for compliance purposes, set the schedule in the Zone Element, Schedules tab.

This completes the mechanical system inputs for a typical gas furnace.

Case Study 2: Packaged Furnace/AC with Exhaust Fans

A small office building (approximately 2,500 sqft) is served by one packaged rooftop furnace/air conditioner with R-4.2 ducts located in the attic. Insulation is at the roof level, so the ductwork is located within indirectly conditioned space. The building also has two 400 cfm (188.8 L/s) bathroom exhaust fans. What inputs are required?

Answer:

1. Create and save the specified packaged unit in the Central System Library, or confirm that the desired unit is already there. You can use the CEC Equipment Directory Database to help input some of the information.
2. The building has been defined as having a single zone. Under the Schedules tab of the Zone element, select CA Daytime Fans for the Fan Schedule (you may leave this Undefined if modeling for Title 24 compliance).
3. Define a 400 cfm (188.8 L/s) exhaust fan in the Exhaust Fan tab of the Room Element. If you are defining all the envelope elements within one Room Element of the Building Tree, enter a multiplier of 2. If you will be further dividing the building for analysis, set the multiplier to 1 and enter the second exhaust fan in the appropriate Room.
4. Open the System Element, General Tab and Name the System, e.g., Office System. Select the packaged unit you created in the Central System Library, and enter a system Multiplier of 1. In the Distribution Tab, enter the duct location, and insulation value.

NOTE: Both the heating and cooling components of the system are combined into one Central System Library entry. It is not possible to have more than one type of Central System in an HVAC System, unless multiple different units have been averaged into one Central System Library entry.

No other inputs are needed to describe this system.

Case Study 3: Packaged VAV without Reheat

A one-story, 5,600 ft² (520.2 m²) office building has a packaged VAV (variable air volume) system with no reheat at the VAV boxes. Both heating and cooling are supplied by the packaged unit. How is this system modeled for compliance? Can the building be modeled as one large zone, or must it be divided into separate zones?

Answer:

1. Any building served by a VAV system must be divided into separate zones that correspond to thermodynamically similar parts of the building. Typical minimum zoning for a one-story, rectangular building, if the actual zoning isn't known, is to have separate perimeter zones for each orientation, plus a central core zone. Multi-story buildings often require additional zones to account for the roof and floor conditions. Refer to the Inputting Zones by Thermal Characteristics and Occupancy Type topic for additional details regarding zoning.

   The first step in defining this system is to divide the building into appropriate thermal zones which will be input as separate Zone Elements under one System Element. Before starting the input in the System and Zone elements, create the equipment in the Central and Zonal System Libraries.

2. In the Central System Library, create a Packaged VAV system that matches the one specified for the building. Since there is no reheat, None for Reheat Coils. Once all the system inputs are complete, save the equipment to the Central System Library and return to the Building Tree.

3. In the Zonal System Library, create all the different types of VAV boxes used in the building. Remember that each zone can use only one type of zonal system. Since there is no terminal reheat in the building, do not check the Reheat Coil checkbox. Save each VAV box to the Library, and return to the Building Tree.

4. In the System Element, name the System and select the equipment you created in the Central System Library, and input other relevant information.

5. The next step is to load the VAV boxes into each Zone. Name each Zone Element and select VAV boxes and multipliers as appropriate. Check that the proper values for Supply ACH (air changes per hour) and Outside ACH have been entered and that the desired schedules have been selected.

This completes the definition of this mechanical system.

Case Study 4: Built-Up VAV with Reheat

A ten-story, 56,000 ft² (5,202.4 m²) office building has a built-up VAV system with hot water reheat coils in the perimeter zones. There are five air handling units, one each for the north, south, east and west perimeter zones, and one for all interior zones. A chiller provides cooling for the whole building, and a boiler supplies all reheat at the zones. There is no other space heating other than the reheat. How is this system modeled for compliance?

Answer:

1. In many respects, the inputs for this built-up VAV system are similar to those for the packaged VAV system defined in Case Study 3. The building must still be divided into zones that correspond to thermally distinct zones. In this case, there are fifteen zones: four perimeter zones and a core zone for the ground floor, a similar five zones for the top floor, and another five zones for the combined interior floors (levels 2 through 9).

2. In the Central System Library, create a built-up VAV system corresponding to each separate air handling unit proposed for the building. The Cooling Output for each unit should equal the rated output of its cooling coil. This example has hot water reheat, so select Hot Water for the Reheat Coils.

Since there is no central heating, under the Heating tab set Heating Type to None and Total Output to zero (0), and select the coil control type from the drop-down list.

Once all the Systems are in the Central Library, open the Zonal Library.

1. In the Zonal System Library, create all the different types of VAV boxes used in the building. Since this example includes reheat in the perimeter zones, check the Reheat Coil checkbox for the boxes to serve the perimeter, and clear it for those serving the core. Save each VAV box to the Library, and return to the Building Tree.
2. Next, open the Chiller Library, and define the Chiller to be used in the building. Then, in the Boiler Library, create the Boiler which will supply hot water to the reheat coils.

This wraps up the Library inputs required for this mechanical system, so return to the Building Tree.

1. Open the Plant Element, and under the Heating Hot Water Tab select the boiler just saved in the Boiler Library. Set the Multiplier to 1. If the service hot water for the building is supplied by the Heating Boiler, leave the DHW System set to Undefined.
2. Continuing in the Plant Element, under the Chilled Water tab, click on the chiller graphic to select the chiller you just saved in the Chiller Library and define the primary chilled water pump characteristics. Set the Multiplier to 1. Enter the Secondary Pump characteristics here as well.
3. In the System Element, select the Central System equipment you defined in the Central System Library. Place each Zone Element under the appropriate System Element in the Building Tree.
4. Now load the VAV boxes into each Zone element as explained in Case Study 3.

California Advanced Homes Program

The CA Advanced Homes program is a publicly-funded program that provides financial incentives for new homes that meet minimum energy efficiency performance requirements. For information regarding program eligibility requirements, or other program-related questions, please contact the appropriate utility, as determined by the project location. The program is implemented by PG&E, SCE, SCG, and SDGE.

You may use EnergyPro to generate an estimate of the potential utility incentive available for a residential new construction project participating in the 2010-2012 Advanced Homes program. In the Incentives section of the Res T24 Performance Calculation Options screen, select the applicable options if the home meets the program requirements. Additional details are below. After the simulation is complete, include Form UTIL-1R in your report when you create it.

You must complete certain fields within the Building Tree to enable the bonus incentive calculations shown on Form UTIL-1R, as listed below. Refer to the program administrator's web sites for additional information and program rules and requirements.

Meets Energy Star Guidelines: Check the box if the project meets Energy Star for Homes guidelines, and may be eligible to receive an incentive bonus. Further information can be reviewed at the EPA Energy Star web site, http://www.energystar.gov.

Certified as a Green Home: Check the box if the home will be inspected by an independent, third-party, provider to verify green building elements have been installed.

Compact Home: The project may be eligible for a kicker if the home is at least 10% smaller than the LEED for Homes square footage threshold for new construction, by number of bedrooms. You must enter the number of bedrooms in the home in the Occupant Tab of the Room Element to enable the calculation.

kW Reduction Incentive: The project may be eligible for an additional incentive for reducing peak demand on the electricity grid by generating a portion of its electricity with an on-site photovoltaic system. Enter the system size and monthly energy generation data in the Renewables Tab of the Plant Element.

NSHP Incentive: The project may be eligible for an incentive by qualifying for the Tier II incentives in the EC's New Solar Homes Partnership (NSHP) program. The project must achieve a 30% reduction in the residential building's combined space heating, space cooling and water heating energy and 30%

reduction in the residential building's space cooling (air conditioning) energy compared to the 2008 Title 24 Standards. Once you enable the kW Reduction incentive, EnergyPro will automatically calculate the NSHP incentive if the project qualifies.

Note that incentive estimates produced here are NOT GUARANTEED. All projects must meet all program requirements to qualify.

Table N2-5: Nonresidential Occupancy Assumptions

View Nonresidential Occupancy Assumptions for additional occupancies.

Table N2-5 – Occupancy Assumptions When Lighting Plans are Submitted for the Entire Building or When Lighting Compliance is not Performed							
Occupancy Type	**Occupants/ 1000sqft**	**Sensible Heat /Occupant (2)**	**Latent Heat /Occupant (2)**	**Receptacle Load W/sqft (3)**	**Hot Water Btu/ h/ person**	**Lighting W/ sqft (4)**	**Ventilatio CFM/sqft (**
Auditoriums (Note 8)	143	245	105	1.00	60	1.50	1.07
Classroom Building	40	246	171	1.00	108	1.10	0.32
Commercial and Industrial Building	5	268	403	0.43	108	0.60	0.15
Convention Centers (Note 8)	136	245	112	0.96	57	1.20	1.02
Financial Institutions	10	250	250	1.50	120	1.10	0.15
General Commercial and Industrial Work Buildings, High Bay	7	375	625	1.00	120	1.00	0.15
General Commercial and Industrial Work Buildings, Low Bay	7	375	625	1.00	120	1.00	0.15
Grocery Stores (Note 8)	29	252	225	0.91	113	1.50	0.22
Library	10	250	250	1.50	120	1.30	0.15
Medical Buildings and Clinics	10	250	213	1.18	110	1.10	0.15
Office Buildings	10	250	206	1.34	106	0.85	0.15
Religious Facilities (Note 8)	136	245	112	0.96	57	1.60	1.03
Restaurants (Note 8)	45	274	334	0.79	366	1.20	0.38
Schools (Note 8)	40	246	171	1.00	108	1.00	0.32

Theaters (Note 8)	130	268	403	0.54	60	1.30	0.98
All Others	10	250	200	1.00	120	0.60	0.15

(1) Most occupancy values are based on an assumed mix of sub-occupancies within the area. These values were based on one half the maximum occupant load for exiting purposes in the CBC. Full value for design conditions. Full year operational schedules reduce these values by up to 50% for compliance simulations and full year test simulations.

(2) From Table 1, p. 29.4, ASHRAE 2001Handbook of Fundamentals

(3) From Lawrence Berkeley Laboratory study. This value is fixed and includes all equipment that is plugged into receptacle outlets.

(4) From Table 146-E of the Standards for the applicable occupancy. The lighting power density of the standard building, for areas where no lighting plans or specifications are submitted for permit and the occupancy of the building is not known, is 1.2 watts per square foot.

(5) Developed from § 121 and Table 121-A of the Standards

(6) Hotel uses values for Hotel Function Area from Table N2-6.

(7) For retail and wholesale stores, the complete building method may only be used when the sales area is 70% or greater of the building area.

(8) For these occupancies, when the proposed design is required to have demand control ventilation by § 121 (c) 3 the ventilation rate is the minimum that would occur at any time during occupied hours. Additional ventilation would be provided through demand controlled ventilation to maintain CO2 levels according to § 121 of the Standards.

Table N2-6: Nonresidential Occupancy Assumptions (cont.)

View Nonresidential Occupancy Assumptions for Complete Building occupancies.

Table N2-6 – Area Occupancy Assumptions When Lighting Plans are Submitted for Portions or for the Entire Building or When Lighting Compliance is not Performed

Sub-Occupancy Type [1]	Occupants /1000sqft	Sensible Heat/ Occupant [3]	Latent Heat/ Occupant [3]	Receptacle Load W/ sqft [4]	Hot Water Btu / h /Occupant	Lighting W/ sqft	Ventilation CFM/ sqft [6]
Auditorium (10)	143	245	105	1.0	60	1.50	1.07
Auto Repair	10	275	475	1.0	120	0.91	1.50
Bar, Cocktail Lounge and Casino (10)	67	275	275	1.0	120	1.10	0.50
Beauty Salon	10	250	200	2.0	120	1.70	0.40
Classrooms, Lecture, Training, Vocational Room	50	245	155	1.0	120	1.20	0.38
Civic Meeting Place (10)	25	250	200	1.5	120	1.30	0.19
Commercial and Industrial Storage (conditioned or unconditioned)	3	275	475	0.2	120	0.60	0.15

Commercial and Industrial Storage (refrigerated)	1	275	475	0.2	0	0.70	0.15
Convention, Conference, Multi-purpose and Meeting Centers (10)	67	245	155	1.0	60	1.40	0.50
Corridors, Restrooms, Stairs, and Support Areas	10	250	250	0.2	0	0.60	0.15
Dining (10)	67	275	275	0.5	385	1.10	0.50
Electrical, Mechanical Room	3	250	250	0.2	0	0.70	0.15
Exercise, Center, Gymnasium	20	255	875	0.5	120	1.00	0.15
Exhibit, Museum (Note 10)	67	250	250	1.5	60	2.00	0.50
Financial Transaction	10	250	250	1.5	120	1.20	0.15
Dry Cleaning (Coin Operated)	10	250	250	3.0	120	0.90	0.30
Dry Cleaning (Full Service Commercial)	10	250	250	3.0	120	0.90	0.45
General Commercial and Industrial Work, High Bay	10	275	475	1.0	120	1. 00	0.15
General Commercial and Industrial Work, Low Bay	10	275	475	1.0	120	0.90	0.15
General Commercial and Industrial Work, Precision	10	250	200	1.0	120	1. 20	0.15
Grocery Sales (10)	33	250	200	1.0	120	1.60	0.25
High-Rise Residential Living Spaces (9)	5	245	155	0.5	(7)	0.50	0.15
Hotel Function Area (Note 10)	67	250	200	0.5	60	1.50	0.50

Hotel/Motel Guest Room (9)	5	245	155	0.5	2800	0.50	0.15
Housing, Public and Common Areas: Multi-family, Dormitory	10	250	250	0.5	120	1.00	0.15
Housing, Public and Common Areas:, Senior Housing	10	250	250	0.5	120	1.50	0.15
Kitchen, Food Preparation	5	275	475	1.5	385	1.60	0.15
Laboratory, Scientific	10	250	200	1.0	120	1.40	0.38
Laundry	10	250	250	3.0	385	0.90	0.15
Library, Reading Areas	20	250	200	1.5	120	1.20	0.15
Library, Stacks	10	250	200	1.5	120	1.50	0.15
Lobby, Hotel	10	250	250	0.5	120	1.10	0.15
Lobby, Main Entry	10	250	250	0.5	60	1.50	0.15
Locker / Dressing Room	20	255	475	0.5	385	0.80	0.15
Lounge, Recreation (Note 10)	67	275	275	1.0	60	1.10	0.50
Malls and Atria (Note 10)	33	250	250	0.5	120	1.20	0.25
Medical and Clinical Care	10	250	200	1.5	160	1.20	0.15
Office (Greater than 250 square feet in floor area)	10	250	200	1.5	120	0.90	0.15
Office (250 square feet in floor area or less)	10	250	200	1.5	120	1.10	0.15
Police Station and Fire Station	10	250	200	1.5	120	0.90	0.15

Religious Worship (Note 10)	143	245	105	0.5	60	1.50	1.07
Retail Merchandise Sales, Wholesale Showroom (Note 10)	33	250	200	1.0	120	1.60	0.25
Tenant Lease Space	10	250	200	1.5	120	1.00	0.15
Theater, Motion Picture) (Note 10)	143	245	105	0.5	60	0.90	1.07
Theater, Performance) (Note 10)	143	245	105	0.5	60	1.40	1.07
Transportation Function (Note 10)	33	250	250	0.5	120	1.20	0.25
Waiting Area	10	250	250	0.5	120	1.10	0.15
All Others	10	250	200	1.0	120	0.60	0.15

(1) Subcategories of these sub-occupancies are described in Section 2.4.1.1 (Occupancy Types) of this manual.

(2) Values based on one half the maximum occupant load for exiting purposes in the CBC. Full value for design conditions. Full year operational schedules reduce these values by up to 50% for compliance simulations and full year test simulations.

(3) From Table 1, p. 29.4, ASHRAE 2001 Handbook of Fundamentals.

(4) From Lawrence Berkeley Laboratory study. This value is fixed and includes all equipment that is plugged into receptacle outlets.

(5) From Table 146-F of the Standards for the applicable occupancy. Compliance software shall use this value for the standard building design when lighting compliance is performed for the zone or area in question.

(6) Developed from 121 and Table 121-A of the Standards.

(7) Refer to residential water heating method.

(8) The use of this occupancy category is an exceptional condition that shall appear on the exceptional conditions checklist and thus requires special justification and documentation and independent verification by the local enforcement agency.

(9) For hotel/motel guest rooms and high-rise residential living spaces all these values are fixed and are the same for both the proposed design and the standard design. Compliance software shall ignore user inputs that modify these assumptions for these two occupancies. Spaces in high-rise residential buildings other than living spaces shall use the values for Housing, Public and Common Areas (either multi-family or senior housing).

(10) For these occupancies, when the proposed design is required to have demand control ventilation by § 121 (c) 3 the ventilation rate is the minimum that would occur at any time during occupied hours. Additional ventilation would be provided through demand controlled ventilation to maintain CO2 levels according to § 121.

Table 4-3: Minimum Ventilation Requirements

Table 4-3 – Required Minimum Ventilation Rate per Occupancy

Occupancy/Use	CBC Occupancy Load sqft /Occ.	CBC Occupancy Load Occ./ sqft	CBC Based Ventilation cfm/sqft	Ventilation from Table 121-A cfm/sqft	Req. Ventilation Largest cfm/sqft
Aircraft Hangars	500	2	0.02	0.15	0.15
Auction Rooms	See Section 1004.7			0.15	N/A
Assembly Areas (Concentrated Use)					
Auditoriums	See Section 1004.7			0.15	N/A
Bowling Alleys	5 Occ/Lane			0.15	N/A
Churches & Chapels (Religious Worship)	7	143	1.07	0.15	1.07
Dance Floors	5	200	1.50	0.15	1.50
Lobbies	15	67	0.50	0.15	0.50
Lodge Rooms	7	143	1.07	0.15	1.07
Reviewing Stands	15	67	0.50	0.15	0.50
Stadiums	See Section 1004.7			0.15	N/A
Theaters - All	See Section 1004.7			0.15	N/A
Waiting Areas	15	67	0.50	0.15	0.50
Assembly Areas (Nonconcentrated Use)	15	67	0.50	0.15	0.50
Conference & Meeting Rooms[1]	15	67	0.50	0.15	0.50
Dining Rooms /Areas	15	67	0.50	0.15	0.50
Drinking Establishments[2]	15	67	0.50	0.20	0.50
Exhibit/ Display Areas	15	67	0.50	0.15	0.50
Gymnasiums/ Sports Arenas	15	67	0.50	0.15	0.50
Lounges	15	67	0.50	0.20	0.50
Stages	15	67	0.50	1.5	1.50
Gaming, Keno, Slot Machine and Live Games Areas	11	91	0.68	0.2	0.68
Auto Repair Workshops	100	10	0.08	1.5	1.50

Barber & Beauty Shops	100	10	0.08	0.4	0.40
Children's Homes & Homes for Aged	120	8	0.06	0.15	0.15
Classrooms	20	50	0.38	0.15	0.38
Courtrooms	40	25	0.19	0.15	0.19
Dormitories	50	20	0.15	0.15	0.15
Dry Cleaning (Coin-Operated)	100	10	0.08	0.30	0.30
Dry Cleaning (Commercial)	100	10	0.08	0.45	0.45
Garage, Parking	200	5	0.04	0.15	0.15
Healthcare Facilities: Sleeping Rooms	120	8	0.06	0.15	0.15
Healthcare Facilities: Treatment Rooms	240	4	0.03	0.15	0.15
Hotels and Apartments	200	5	0.04	0.15	0.15
Hotel Function Area[3]	7	143	1.07	0.15	1.07
Hotel Lobby	100	10	0.08	0.15	0.15
Hotel Guest Rooms (<500 ft²)	200	5	0.04	Footnote 4	Footnote 4
Hotel Guest Rooms (>=500 ft²)	200	5	0.04	0.15	0.15
Highrise Residential	200	5	0.04	Footnote 5	N/A
Kitchen(s)	200	5	0.04	0.15	0.15
Library: Reading Rooms	50	20	0.15	0.15	0.15
Library: Stack Areas	100	10	0.08	0.15	0.15
Locker Rooms	50	20	0.15	0.15	0.15
Manufacturing	200	5	0.04	0.15	0.15
Mechanical Equipment Room	300	3	0.03	0.15	0.15
Nurseries for Children-Day Care	35	29	0.21	0.15	0.21
Offices					
Office	100	10	0.08	0.15	0.15
Bank/ Financial Institution	100	10	0.08	0.15	0.15

Medical & Clinical Care	100	10	0.08	0.15	0.15
Retail Stores (See Stores)					
School Shops & Vocational Rooms	50	20	0.15	0.15	0.15
Skating Rinks: Skate Area	50	20	0.15	0.15	0.15
Skating Rinks: On Deck	15	67	0.50	0.15	0.50
Stores					
Retail Sales, Whole-sale Showrooms	30	33	0.25	0.2	0.25
Basement and Ground Floor	30	33	0.25	0.2	0.25
Upper Floors	60	17	0.13	0.2	0.20
Grocery	30	33	0.25	0.2	0.25
Malls, Arcades and Atria	30	33	0.25	0.2	0.25
Swimming Pools: Pool Area	50	20	0.15	0.15	0.15
Swimming Pools: On Deck	15	67	0.50	0.15	0.50
Warehouses, Industrial & Commercial Storage/Stockrooms	500	2	0.002	0.15	0.15
All Others					
Including Unknown	100	10	0.08	0.15	0.15
Corridors, Restrooms, & Support Areas	100	10	0.08	0.15	0.15
Commercial & Industrial Work	100	10	0.08	0.15	0.15

	Footnotes	Equations used to find:
1	*Convention, Conference, Meeting Rooms*	*Equation 1*[6] $\frac{NumberOfPeople}{1{,}000sqft} = \frac{1{,}000}{sqft/Occupants}$
2	*Bars, Cocktail & Smoking Lounges, Casinos*	
3	*See Conference Rooms or Dining Rooms*	*Equation 2*[7] $\text{CBC Based Ventilation } (\frac{\text{cfm}}{\text{sqft}}) = 15\text{cfm}(\frac{\text{Occupants per}\frac{1000\text{sqft}}{1000}}{2})$
4	*Guestrooms less than 500 ft² use 30 cfm/guestroom*	
5	*Highrise Residential See 1994 UBC Section 1203 Ventilation*	

Table N2-13: Standard Design HVAC System Selection

Table N2-13 – Standard Design HVAC System Selection			
Building Type	**System Type**	**Heating Source**	**System**
Low-Rise Nonresidential (three or fewer stories above grade)	Single Zone	-----Fossil----	System 1 – Packaged Single Zone, Gas/Electric
		-----Electric----	System 2 – Packaged Single Zone, Heat Pump
	Multiple Zone	Any	System 3 – Packaged VAV, Gas Boiler with Reheat
High Rise Nonresidential (four or more stories)	Single Zone	Any	System 5 – Built-up Single Zone System with Central Plant
	Multiple Zone	Any	System 4 – Central VAV, Gas Boiler with Reheat
All Residential including Hotel / Motel Guest Room	Hydronic	Any	System 5 – Four Pipe Fan Coil System with Central Plant
	Other	------Fossil-----	System 1 (No economizer) – Packaged Single Zone, Gas/Electric
		------Electric----	System 2 (No economizer) – Packaged Single Zone, Heat Pump

Table 6.5.3.1.1B: Fan Power Limitation Pressure Drop Adjustment

Table 6.5.3.1.1B Fan Power Limitation Pressure Drop Adjustment	
Device	**Adjustment**
Credits	
Fully ducted return and/or exhaust air systems	0.5 in. w.c.
Return and/or exhaust airflow control devices	0.5 in. w.c.
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design conditions
Particulate Filtration Credit: MERV 9 through 12	0.5 in. w.c.

Particulate Filtration Credit: MERV 13 through 15	0.9 in. w.c.
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated a 2x clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design conditions
Heat recovery device	Pressure drop device at fan system design conditions
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop device at fan system design conditions
Sound Attenuation Section	0.15 in. w.c.
Deductions	
Fume Hood Exhaust Exception (required if 6.5.3.1.1 Exception [c] is taken)	-1.00 in. w.c.

Table D-4: Central System Inputs by System Type

Table D-4 Central System Inputs by System Type

	Split FAU- A/C	Packaged FAU-A/C	Split Heat Pump	Pkaged Heat Pump	Split Electric – A/C	Pkged Electric-A/C	Hydron.Heat Pump	Packaged VAV	Packaged MZ	Built-Up SZ	Built-Up VAV	Built-Up MZ	Dual Duct (SglFan)	4-Pipe Fan Coil	Furnace-Room A/C	Electric-Room A/C	Room Heat Pump	Packaged VVT	4 Pipe Induction	FAU-Evap. Cooling	Elec Evap. Cooling
System Name	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
System Type	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Heating																					
Heating Coil																					
Heating Type	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Furnace Type	■	■						■							■			■		■	
Coil Control								■	■	■	■	■	■					■	■		
Total Output	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Electrical Power (kW)			■	■	■	■											■				
Supply Temperature	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Efficiency	■	■	■	■	■	■	■	■							■	■	■	■		■	■
Pre-Heat Coils																					

Pre-heat Source								■		■	■	■	■						■		
Setpoint								■		■	■	■	■						■		
Reheat Coils																					
Reheat Source	■	■	■	■	■	■		■		■	■							■		■	■
Delta T	■	■	■	■	■	■		■		■	■							■		■	■
Baseboard Heat																					
Baseboard Heat Source	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cooling																					
Cooling Coil																					
Coil Control								■	■	■	■	■	■					■	■		
Output	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Sensible	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Supply Temperature	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Efficiency	■	■	■	■	■	■		■	■						■	■	■	■			
Fan Heat Included in Output	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Performance at ARI Cond.																					
EER	■	■	■	■	■	■	■	■	■						■	■	■	■			
Comp/Condenser Power	■	■	■	■	■	■	■	■	■						■	■	■	■			
Condenser																					
Condenser Type	■	■	■	■	■	■		■	■									■			
Ice Storage A/C																					
Evap. Pre-Cooled Cond. Eff.	■	■	■	■	■	■		■	■									■			
Pump Motor Inputs	■	■	■	■	■	■		■	■									■			
Room A/C & Heat Pump																					
Side Louvers															■	■	■				
Controls																					
Fan Operation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cycle System on @ Night																					
DDC Controls to Zone Level																					
Fault Detection & Diagnostic Controls																					
Maximum Humidity																					
Outdoor Air																					
Air Economizer																					

Characteristics																					
Economizer Type	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■
Limit Temperature	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■
Water Side Economizer	■	■	■	■	■	■		■										■			
Exhaust Air Heat Recovery																					
Energy Recovered																					
Heat Recovery Effectiveness																					
Min. Delta T req. for Heat Recovery																					
Electrical Energy Use																					
Pump/Motor runs only when Heat Recovery is in Bypass Mode																					
Fan Savings when Heat Recovery is in Bypass Mode																					
Exhaust Air Stream Evap Cooling Effectiveness																					
Fans																					
Induction Ratio																					
Supply Fan																					
Fan Control								■	■	■	■	■	■					■	■		
Fan Type	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Airflow	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Design Power	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Drive Efficiency	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Premium Efficiency	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Return Fan																					
Airflow	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■
Design Power	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■
Drive Efficiency	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■
Premium Efficiency	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■
Evaporative Cooling																					
Evaporative Cooling Characteristics																					
Evaporative Cooling Type	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■
Airflow	■	■	■	■	■	■		■	■	■	■	■	■					■	■	■	■

Direct Effectiveness	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Indirect Effectiveness	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Integrated Operation	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Return Air Heat Recovery	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Supplemental Fan																					
Design Power	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Drive Efficiency	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Premium Efficiency	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Pump																					
Design Power	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Drive Efficiency	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Premium Efficiency	▮	▮	▮	▮	▮	▮		▮	▮	▮	▮	▮	▮					▮	▮	▮	▮
Curves																					
Use Custom Heating Curve Coefficients																					
Output DB																					
Capacity																					
Input kW																					
Use Custom Heating Curve Coefficients																					
Output DB																					
Capacity																					
Input kW																					

Table 146-H: Mounting Height Multipliers

Table 146-H: Adjustments for Mounting Height Above Floor		
Height above finished floor and bottom of luminaire(s)	**Floor Display - Multiply by**	**Wall Display - Multiply by**
≥11'6	1.00	1.00
<11'6" to ≤ 16'	1.20	1.15
>16' to ≤ 20'	1.40	1.35
>20'	2.00	1.75

Table 116-A Default Fenestration Product U-Factors

Table 116-A Default Fenestration Product U-Factors				
Frame	**Product Type**	**Single Pane U-Factor**	**Double Pane U-Factor[1]**	**Glass Block U-Factor[2]**
Metal	Operable	1.28	0.79	0.87
	Fixed	1.19	0.71	0.72
	Greenhouse/Garden Window	2.26	1.40	N.A.
	Doors	1.25	0.77	N.A.
	Skylight	1.98	1.30	N.A.
Metal, Thermal Break	Operable	N.A.	0.66	N.A.
	Fixed	N.A.	0.55	N.A.
	Greenhouse/Garden Window	N.A.	1.12	N.A.
	Doors	N.A.	0.59	N.A.
	Skylight	N.A.	1.11	N.A.
Nonmetal	Operable	0.99	0.58	0.60
	Fixed	1.04	0.55	0.57
	Greenhouse/Garden Window	1.94	1.06	N.A.
	Doors	0.99	0.53	N.A.
	Skylight	1.47	0.84	N.A.

1. For all dual-glazed fenestration products, adjust the listed U-factors as follows:
   a. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide
   b. Add 0.05 to any product with true divided lite (dividers through the panes.)
2. Translucent or transparent panels shall use glass block values

Table 116-B Default Solar Heat Gain Coefficient

Table 116-B Default Solar Heat Gain Coefficient (SHGC)					
Frame Type	**Product**	**Glazing**	**Total Window SHGC**		
			Single Pane	**Double Pane**	**Glass Block[1]**
Metal	Operable	Clear	0.80	0.70	0.70
	Fixed	Clear	0.83	0.73	0.73
	Operable	Tinted	0.67	0.59	N.A.
	Fixed	Tinted	0.68	0.60	N.A.
Metal, Thermal Break	Operable	Clear	N.A.	0.63	N.A.
	Fixed	Clear	N.A.	0.69	N.A.
	Operable	Tinted	N.A.	0.53	N.A.
	Fixed	Tinted	N.A.	0.57	N.A.
Nonmetal	Operable	Clear	0.74	0.65	0.70
	Fixed	Clear	0.76	0.67	0.67
	Operable	Tinted	0.60	0.53	N.A.
	Fixed	Tinted	0.63	0.55	N.A.

1. Translucent or transparent panels shall use glass block values

Nonresidential Appendix NA6-2008 Tables

Appendix NA6: Alternate Default Fenestration Procedure to Calculate Thermal Performance (for fenestration products excepted from 116-A & 116-B)

NA6.2 Default U-Factor

The default U-Factor shall be determined using the following equation:

Equation NA6-1		$U_T = C_1 + C_2 XU_C$
Where:	U_T =	The fenestration product U-Factor
	C_1 =	Coefficient selected from Table NA6-1
	C_2 =	Coefficient selected from Table NA6-1
	U_C =	Center of glass U-Factor

Table NA6-1 U-Factor Coefficients

Product Type	Frame Type	C_1	C_2
Site-Built Vertical Fenestration	Metal	0.311	0.872
	Metal, Thermal Break	0.202	0.867
	Non-Metal	0.202	0.867
Skylights with a Curb	Metal	0.711	1.065
	Metal, Thermal Break	0.437	1.229
	Non-Metal	0.437	1.229
Skylights with no Curb	Metal	0.195	0.882
	Metal, Thermal Break	0.310	0.878
	Non-Metal	0.310	0.878

NA6.3 Default Solar Heat Gain Coefficient

The SHGC of the fenestration product shall be calculated using the following equation:

Equation NA6-2		$SHGC_T = 0.08 + 0.86 \times SHGC c$
Where:	$SHGC_T$ =	SHGC for the fenestration including glass and frame
	SHGCc =	SHGC for the center of glass alone

Table 12-12: NEMA Premium® Efficiency Motor Ratings

Table 12-12: NEMA Premium® Efficiency Electric Motors Full Load Efficiencies - Enclosed Motors (4 Pole, Random Wound)		
HP	**Nominal Efficiency**	**Minimum Efficiency**
1	85.5	82.5
1.5	86.5	84.0

2	86.5	84.0
3	89.5	87.5
5	89.5	87.5
7.5	91.7	90.2
10	91.7	90.2
15	92.4	91.0
20	93.0	91.7
25	93.6	92.4
30	93.6	92.4
40	94.1	93.0
50	94.5	93.6
60	95.0	94.1
75	95.4	94.5
100	95.4	94.5
125	95.4	94.5
150	95.8	95.0
200	96.2	95.4
250	96.2	95.4
300	96.2	95.4
350	96.2	95.4
400	96.2	95.4
450	96.2	95.4
500	96.2	95.4

Source: NEMA Standards Publication MG 1- 2006

Table 6-1 Scope of the Outdoor Lighting Requirements

Table 6-1 Scope of the Outdoor Lighting Requirements		
Lighting Applications Covered		**Lighting Applications Not Regulated (only as detailed in § 147)**
General Hardscape (tradeoffs permitted)	**Specific Applications (tradeoffs not permitted)**	
The general hardscape area of a site shall include parking lot(s), roadway(s), driveway(s), sidewalk(s), walkway(s), bikeway(s), plaza(s), and other	Canopies: Sales and Non-sales Drive-Up Windows Emergency Vehicle Facilities	Temporary Required & regulated by FAA and Coast Guard For public streets, roadways, highways and traffic signage lighting,

improved area(s) that are illuminated.		and occurring in the public right-of-way
	Entrances or Exits	For sports and athletic fields, and children's playground
	Guard Stations	For industrial sites
	Ornamental Lighting	For ATM required ;by law
	Outdoor Dining	For public monuments
	Primary Entrances for Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities	For water features subject to Article 680 of the California Electrical Code
	Sales Frontage and Lots	Signs
	Special Security Lighting for Retail Parking and Pedestrian Hardscape	For tunnels, bridges, stairs, wheelchair elevator lifts
	Student Pick-up/Drop off zone	For ramps other than parking garage ramps
	Vehicle Service Station : Canopies, Hardscape, and Uncovered Fuel Dispenser	Landscape lighting
		For themes and special effects
		For theatrical and other outdoor live performances
		For qualified historic buildings

Other outdoor lighting applications that are not included in Standards Tables 147-A, 147-B, or 147-C are assumed to be not regulated by these Standards. This includes decorative gas lighting and emergency lighting powered by an emergency source as defined by the California electrical code. The text in the above list of lighting applications that are not regulated has been shortened for brevity. Please see Section 6.1.2 B of the Nonresidential Manual for details about lighting applications not regulated.

Table 6-3: General Hardscape Lighting Power Allowance

Table 6-3 (Table 147-A in the Standards)
General Hardscape Lighting Power Allowance

Type of Power Allowance	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Area Wattage Allowance (AWA)	0.036 W/sqft	0.045 W/sqft	0.092 W/sqft	0.115 W/sqft
Linear Wattage Allowance (LWA)	0.36 W/sqft	0.45 W/sqft	0.92 W/sqft	1.15 W/sqft
Initial Wattage Allowance (IWA)	340 W	510 W	770 W	1030 W

Table 6-4: Additional Lighting Power Allowance For Specific Applications

Table 6-4 (Table 147-B in the Standards) Additional Lighting Power Allowance for Specific Applications				
Lighting Application	**Lighting Zone 1**	**Lighting Zone 2**	**Lighting Zone 3**	**Lighting Zone 4**
All area and distance measurements in plan view unless otherwise noted.				
WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.				
Building Entrances or Exits. Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door.	30 watts	75 watts	100 watts	120 watts
Primary Entrances, Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities. Allowance per primary entrances(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance.	45 watts	80 watts	120 watts	130 watts
Drive Up Windows. Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window.	40 watts	75 watts	125 watts	200 watts
Vehicle Service Station Uncovered Fuel Dispenser. Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser.	120 watts	175 watts	185 watts	330 watts
WATTAGE ALLOWANCE PER UNIT LENGTH (W/linear ft.). May be used for one or two frontage side(s) per site				
Outdoor Sales Frontage. Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area.	No Allowance	22.5 W/ linear ft.	36 W/ linear ft.	45 W/ linear ft.
WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/sqft). May be used for any illuminated hardscape area on the site.				
Hardscape Ornamental Lighting. Allowance for the total site illuminated hardscape area. Luminaires qualifying for this allowance shall be rated for 100 watts or less as determined in accordance with Section 130(d), and shall be post-top luminaires, lanterns, pendant luminaires, or chandeliers.	No Allowance	0.02 W/sqft	0.04 W/sqft	0.06 W/sqft
WATTAGE ALLOWANCE PER SPECIFIC AREA (W/sqft) Use as appropriate provided that none of the following				

specific applications shall be used for the same area.				
Building Facades. Only areas of building façade that are illuminated shall qualify for this allowance. Luminaires qualifying for this allowance shall be aimed at the façade and shall be capable of illuminating it without obstruction interference by permanent building features or other objects.	No Allowance	0.18 W/sqft	0.35 W/sqft	0.50 W/sqft
Outdoor Sales Lots. Allowance for uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale. Driveways, parking lots or other non-sales areas shall be considered hardscape areas even if these areas are completely surrounded by sales lot on all sides. Luminaires qualifying for this allowance shall be within 5 mounting heights of the sales lot area.	0.164 W/sqft	0.555 W/sqft	0.758 W/sqft	0.1.285 W/sqft
Vehicle Service Station Hardscape. Allowance for the total illuminated hardscape area less area of buildings, under canopies, off property, or obstructed by signs or structures. Luminaires qualifying for this allowance shall be illuminating the hardscape area and shall not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.	0.014 W/sqft	0.155 W/sqft	0.308 W/sqft	0.485 W/sqft
Vehicle Service Station Canopies. Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.	0.514 W/sqft	1.005 W/sqft	1.358 W/sqft	2.285 W/sqft
Sales Canopies. Allowance for the total area with the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy	No Allowance	0.655 W/sqft	0.908 W/sqft	1.135 W/sqft
Non-sales Canopies. Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy..	0.084 W/sqft	0.205 W/sqft	0.408 W/sqft	0.585 W/sqft
Guard Stations. Allowance up to 1,000 square feet per vehicle lane. Guard stations provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants, including identification, documentation, vehicle license plates, and vehicle contents. Qualifying luminaires shall be within 2 mounting heights of a vehicle lane or the guardhouse.	0.154 W/sqft	0.355 W/sqft	0.708 W/sqft	0.985 W/sqft
Student Pick-up/Drop-off Zone. Allowance for the area of the student pick-up/drop-off zone, with or without canopy, for preschool through 12th grade school campuses. A student pick-up/drop-off zone is a curbside, controlled traffic area on a school campus where students are picked-up and dropped off from vehicles. The allowed area shall be the smaller of the actual width or 25 feet, times the smaller of the actual length or 250 feet. Qualifying luminaires shall be within 2 mounting heights of the pick-up/drop-off zone	No Allowance	0.12 W/sqft	0.45 W/sqft	No Allowance
Outdoor Dining. Allowance for the total illuminated hardscape of outdoor dining. Outdoor dining areas are hardscape areas used to serve and consume food and beverages. Qualifying luminaires shall be within 2 mounting heights of the hardscape area of outdoor dining.	0.014 W/sqft	0.135 W/sqft	0.258 W/sqft	0.435 W/sqft
Special Security Lighting for Retail Parking and Pedestrian Hardscape. This additional allowance is for illuminated retail parking and pedestrian hardscape identified as having special security needs. This allowance shall be in addition to the building	0.007 W/sqft	0.009 W/sqft	0.019 W/sqft	No Allowance

entrance or exit allowance				

Table 7: Rules for Determining Luminaire (Lighting Fixture) Count (CEC HERS Technical Manual)

Table 7: Rules for Determining Luminaire (Lighting Fixture) Count		
Luminaire Type	**Examples/Description**	**Method of Counting**
Track Lighting	Line-voltage or low-voltage track	Larger of: One luminaire for each 3 feet of track length rounded up to 3 foot multiple, or Actual number of track heads installed.
Linear Fluorescent (see Note 1)	Linear fluorescent luminaire, factory-installed ballast	One luminaire per individual factory- made luminaire, regardless of number of lamps per luminaire
LED (see Note 2)	Single diodes or clusters of diodes	One luminaire per cluster
	Linear row of diodes	One luminaire for each 3 foot length, rounded up to 3 foot multiple.
Chandeliers with non-medium based sockets	Chandeliers with candelabra or pin-based sockets	Count = 1 for luminairies with one lamp or one socket Count = 1 luminaire for every ten sockets, rounded up to the nearest whole number, for luminaires with multiple lamps or sockets.
All Other	Incandescent luminaires including low- voltage or line-voltage	Count = 1 for luminaires with one lamp or one socket Count = 1 luminaire for every two sockets, rounded up to the nearest whole number, for luminaires with multiple lamps or sockets.

Note 1: A factory-made luminaire is a complete lighting unit consisting of lamps and the parts designed to distribute the light, to position and protect the lamps, and to connect the lamp to the power supply.

Note 2: LED system, no screw bases, includes optics and power supply.

Table 8: Permanently Installed Luminaire Types (CEC HERS Technical Manual)

Table 8 Permanently Installed Luminaire Types	
Classification	**Definition**
Permanently Installed High Efficacy	Meets the requirements of §152(k). Includes luminaires that can accept only linear fluorescent, compact fluorescent or LED lamps.
Low Efficacy	Any luminaire that accepts any type of incandescent lamp, and that has incandescent lamps installed
Screw-in High Efficacy	Any luminaire that accepts screw-based incandescent lamps, but that has screw-based compact fluorescent or screw-based LED installed. Any track lighting track that accepts medium screw-based incandescent lamps, but that has medium screw-based track head with screw-in CFL, CFL track heads with factory installed ballast, or LED track heads.

Table 2-3: Measures Requiring Acceptance Testing

Table 2-3 Measures Requiring Acceptance Testing	
Category	**Measure**
Envelope	
Fenestration Acceptance	Fenestration-Label Certificate Verification
Mechanical	
Outdoor Air	Variable Air Volume Systems Outdoor Air Acceptance
	Constant Volume System Outdoor Air Acceptance
HVAC Systems	Constant Volume Single Zone, Unitary A/C and Heat Pumps
Air Distributions Systems	Air Distribution Acceptance
Air Economizer Controls	Economizer Acceptance
Demand Control Ventilation (DCV) Systems	Packaged Systems DCV Acceptance
Variable Frequency Drive Systems	Supply Fan Variable Flow Controls
Hydronic System Controls Acceptance	Valve Leakage Test
	Hydronic Variable Flow Controls
	Supply Water Temperature Reset Controls
Mechanical Systems	Automatic Demand Shed Control Acceptance
	Fault Detection & Diagnostics for DX Units
	Automatic Fault Detection & Diagnostics for Air Handling & Zone Terminal Units
	Distributed Energy Storage DX A/C Systems Test
	Thermal Energy Storage (TES) Systems
Lighting	
Indoor Lighting Control Systems	Automatic Daylighting Controls Acceptance
	Occupancy Sensor Acceptance
	Manual Daylighting Controls Acceptance
	Automatic Time Switch Control Acceptance
Outdoor Lighting	

Outdoor Lighting Control	Outdoor Motion Sensor Acceptance Outdoor Lighting Shut-off Controls Outdoor Photocontrol Astronomical Time Switch Standard (non-astronomical) Time Switch

TABLE R3-30: SUMMARY OF STANDARD DESIGN HVAC SYSTEM

TABLE R3-30: SUMMARY OF STANDARD DESIGN HVAC SYSTEM				
Proposed Design		**Standard Design**		
Heating System	**Cooling System**	**Heating System**	**Cooling System**	**Detailed Specifications**
Through-the-wall heat pump		Same equipment as proposed design with no air distribution ducts		Equipment efficiency determined by CEC Appliance Efficiency Regulations
Gas wall furnace with or without ducts and/or circulation fan	Any	Same equipment as proposed design with no air distribution ducts	Split system heat pump with air distribution ducts	
Any other electric heat including electric resistance, water source heat pump, etc.	Any	Split system heat pump with air distribution ducts		SEER per Package D Verified refrigerant charge (prescriptive requirement)
All other gas heating	Any	Split system air conditioner with gas furnace and air distribution ducts		No credit for sizing No credit for cooling coil airflow No credit for reduced fan power
Note: The standard design cooling system is also used for the proposed design if the proposed design has no air conditioning.				

TABLE R3-31-SUMMARY OF STANDARD DESIGN AIR DISTRIBUTION SYSTEM

TABLE R3-31: SUMMARY OF STANDARD DESIGN AIR DISTRIBUTION SYSTEM		
Configuration of the Proposed Design	**Standard Design**	
	Standard Design Duct	**Detailed Specifications**

	Location	
Attic over the dwelling unit	Ducts and air handler located in the attic	Ducts sealed (prescriptive requirements) No credit for reduced duct area No credit for increased duct R-value or buried ducts No credit for low-leakage air handler
No attic but crawlspace or basement	Ducts and air handler located in the crawlspace or basement	
No attic, crawlspace or basement	Ducts and air handler located indoors	

This table is applicable only when the standard design system has air distribution ducts as determined in Table R3-30.

TABLE R3-50: DEFAULT ASSUMPTIONS FOR EXISTING BUILDINGS-VINTAGE TABLE VALUES

TABLE R3-50: DEFAULT ASSUMPTIONS FOR EXISTING BUILDINGS VINTAGE TABLE VALUES

Default Assumptions for Year Built (Vintage)

Conservation Measure	Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 to 2000	2001 to 2003	2004 to 2005	2006 & Later
INSULATION U-FACTOR								
Roof/Ceiling	0.079	0.049	0.049	0.049	0.049	0.049	0.049	0.049
Wall	0.356	0.110	0.110	0.102	0.102	0.102	0.102	0.102
Raised Floor-Crawlspace	0.099	0.099	0.099	0.046	0.046	0.046	0.046	0.046
Cool Roof	0.100	0.100	0.100	0.100	0.100	0.100	0.100	Pres Pkg.
Radiant Barrier	None	None	None	None	None	None	Pres Pkg.	Pres Pkg.
Raised Floor-No Crawlsp.	0.238	0.238	0.238	0.064	0.064	0.064	0.064	0.064
Slab Edge F-factor	0.730	0.730	0.730	0.730	0.730	0.730	0.730	0.730
Ducts	R-2.1	R-2.1	R-2.1	R-4.2	R-4.2	R-4.2	R-4.2	Pres Pkg.
LEAKAGE								
Building (SLA)	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900
Duct Leakage Factor (See Res Man Table 4-13)	0.860	0.860	0.860	0.860	0.860	0.890	0.890	0.890
FENESTRATION								
U-Factor	Use Standards Table 116-A, §116 for all Vintages							
SHGC	Use Standards Table 116-B, §116 for all Vintages							
Shading Device	Use Tables R3-27 & R3-28 for all Vintages in the Res.ACM Manual-Performance Approach							
SPACE HEATING EFFICIENCY								
Gas Furnace (Central) AFUE	0.750	0.780	0.780	0.780	0.780	0.780	0.780	0.780
Gas Heater (Room) AFUE	0.650	0.650	0.650	0.650	0.650	0.650	0.650	0.650
Hydronic/Combo Hydronic	0.780	0.780	0.780	0.780	0.780	0.780	0.780	0.780
Heat Pump HSPF	5.600	5.600	6.600	6.600	6.800	6.800	6.800	7.400
Electric Resistance HSPF	3.413	3.413	3.413	3.413	3.413	3.413	3.413	3.413
Electric Resistance Radiant HSPF	3.550	3.550	3.550	3.550	3.550	3.550	3.550	3.550
SPACE COOLING EFFICIENCY								

All Types SEER	8.000	8.000	8.900	9.700	9.700	9.700	9.700	13.00
WATER HEATING								
Energy Factor	0.525	0.525	0.525	0.525	0.575	0.575	0.575	0.575

Table 5: RESNET Reference Home Dishwasher Assumptions

Table 5: RESNET Reference Home Dishwasher Assumptions		
Occupants	**Cycles / year**	**Reference Dishwasher kWh/year**
2	154	90
3	214	126
4	247	145
5	296	174
6 or more	345	203

TABLE 6: DAILY LIGHTING HOURS - INTERIOR

TABLE 6: DAILY LIGHTING HOURS – INTERIOR	
Location	**Daily Hours**
Small Closet	0.5
Bedroom / Walk In Closet	1.4
Hall Entry / Stairs / Other	2.0
Living	2.6
Utility / Laundry	2.6
Kitchen / Dining / Nook	3.4

TABLE 10: DAILY LIGHTING HOURS - EXTERIOR

TABLE 10: DAILY LIGHTING HOURS – EXTERIOR	
Location	**Daily Hours**
Indoor Garage	2.3
Outdoor – Front Entry	6.0
Outdoor – Other (side/back)	2.0

Table 151-C: Component Package D

TABLE 151-C Component Package D																	
			Climate Zone														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Insulation minimums[1]	Ceilings		R38	R30	R30	R30	R30	R30	R30	R30	R30	R30	R38	R38	R38	R38	R38	R38
	Walls	Wood-frame walls	R21	R13	R13	R13	R13	R13	R13	R13	R13	R13	R19	R19	R19	R21	R21	R21
		Heavy mass walls	R4.76	R2.44	R2.44	R2.44	R2.44	R2.44	R2.44	R2.44	R2.44	R2.44	R4.76	R4.76	R4.76	R4.76	R4.76	R4.76
		Light mass walls	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Below-grade walls	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R13
	Floors	Slab floor perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R7
		Raised floors	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19
		Concrete raised floors	R8	R8	R0	R0	R0	R0	R0	R0	R0	R0	R8	R4	R8	R8	R4	R8
Radiant Barrier			NR	REQ	NR	REQ	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.55	NR	0.55	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
	Steep-sloped (<5lb/sqft)	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
	Steep-sloped (≥5lb/sqft)	Aged Solar Reflectance	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
		Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Fenestration	Maximum U-Factor[2]		0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	Maximum Solar Heat Gain Coefficient (SHGC)[3]		NR	0.40	NR	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.35	NR
	Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Maximum West Facing Area		NR	5%	NR	5%	NR	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	NR
Thermal Mass[4]			NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Space	Electric resistant allowed		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

Heating[5, 10]	If gas, AFUE=	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
	If heat pump, HSPF[6]	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
Space Cooling	SEER=	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
	If split system, refrigerant charge measurement or charge indicator display	NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
Central Forced-Air Handlers	Cooling Airflow and Watt Draw	NR	NR	NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	NR
	Central Fan Integrated Ventilation System	REQ	REQ	REQ[2]	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
Ducts	Duct Sealing	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Duct Insulation	R-6	R-6	R-6	R-6	R-6	R-4.2	R-4.2	R-4.2	R-6	R-6	R-6	R-6	R-6	R-8	R-8	R-8
Water Heating		System shall meet Section 151(f)8 or Section 151(b)1															

Notes:

1 The R-values shown for ceiling, wood frame wall and raised floor are for wood-frame construction with insulation installed between the framing members. For alternative construction assemblies, see Section 151(f)1A.

The heavy mass R-value in parentheses is the minimum R-value for the entire wall assembly if the wall weight exceeds 40 pounds per sq ft. The light mass wall R-value in brackets is the minimum R-value for the entire assembly if the heat capacity of the wall meets or exceeds the result of multiplying the bracketed minimum R-value by 0.65. Any insulation installed on heavy or light mass walls must be integral with, or installed on the outside of, the exterior mass. The inside surface of the thermal mass, including plaster or gypsum board in direct contact with the masonry wall, shall be exposed to the room air. The exterior wall used to meet the R-value in parentheses cannot also be used to meet the thermal mass requirement.

2 The installed fenestration products shall meet the requirements of Section 151(f)3.

3 The installed fenestration products shall meet the requirements of Section 151(f)4.

4 If the package requires thermal mass, the thermal mass shall meet the requirements of Section 151(f)5.

5 Thermostats shall be installed in conjunction with all space heating systems in accordance with Section 151(f)9.

6 HSPF means “heating seasonal performance factor.”

10 A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kilowatts or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.

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